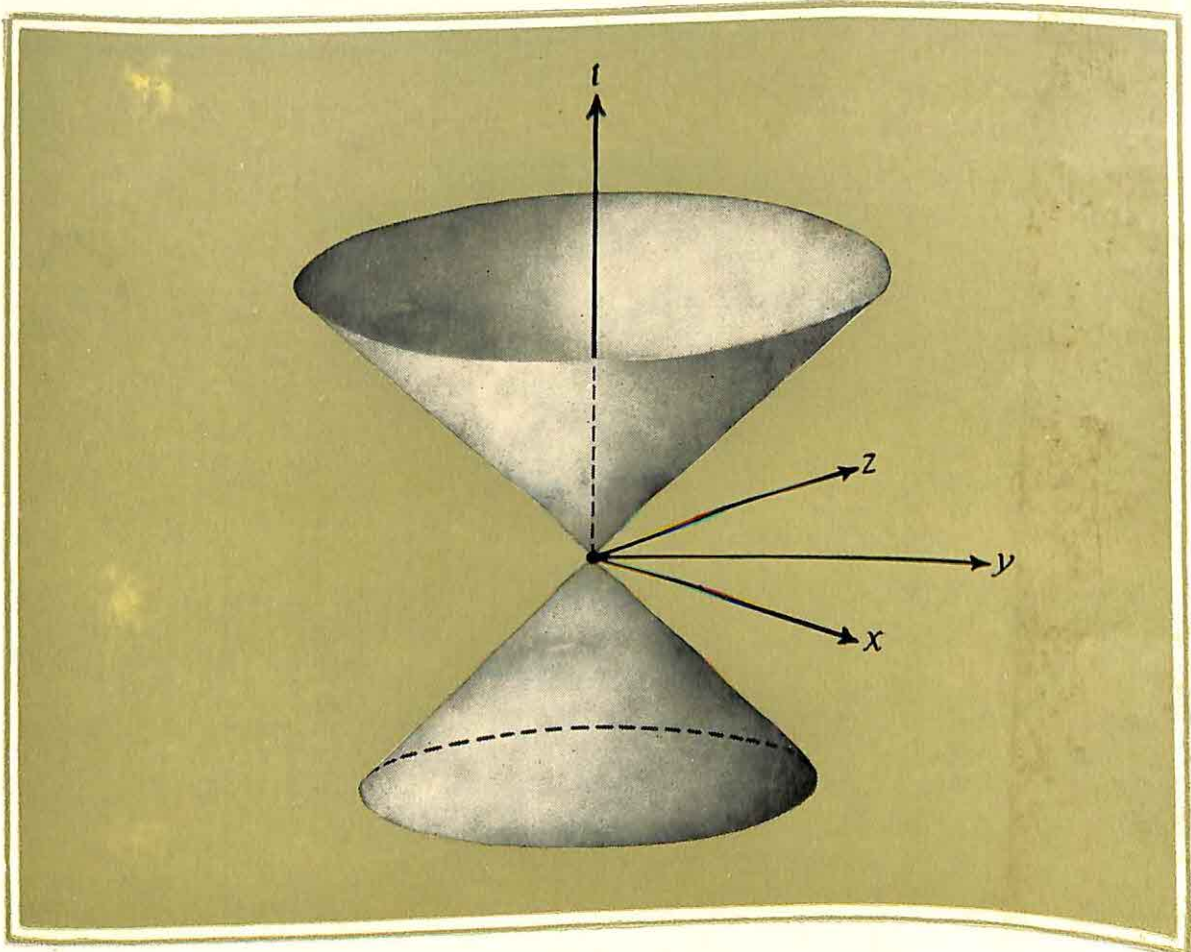


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M A T H S

FOR CIVIL SERVICES PRELIMINARY EXAMINATION

by

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PREFACE

Preliminary Examination of the Civil Services Examination for recruitment to (i) Indian Administrative Service ; (ii) Indian Foreign Service ; (iii) Indian Police Service ; (iv) Indian P & T Accounts and Finance Service, Group A ; (v) Indian Audit and Accounts Service, Group A ; (vi) Indian Customs and Central Excise Service, Group A ; (vii) Indian Defence Accounts Service, Group A ; (viii) Indian Income Tax Service, Group A ; (ix) Indian Ordnance Factories Service, Group A (Assistant Manager—non-technical) ; (x) Indian Postal Service, Group A ; (xi) Indian Civil Accounts Service, Group A ; (xii) Indian Railway Traffic Service, Group A ; (xiii) Indian Railway Accounts Service, Group A ; (xiv) Indian Railway Personnel Service, Group A ; (xv) Posts of Assistant Security Officers, Group A in Railway Protection Force ; (xvi) Military Lands and Cantonments Service, Group A ; (xvii) Central Information Service, Group A (Grade II) ; (xviii) Central Trade Service, Group A (Grade III) ; (xix) Central Secretariat Service, Group B (Section Officers' Grade) ; (xx) Railway Board Secretariat Service, Group B (Section Officers' Grade) ; (xxi) Indian Foreign Service, Group B (Section Officers' Grade) ; (xxii) Armed Forces Headquarters Civil Service, Group B (Assistant Civilian Staff Officers' Grade) ; (xxiii) Customs' Appraisers' Service, Group B ; (xxiv) Delhi and Andaman & Nicobar Islands Civil Service, Group B ; (xxv) Goa, Daman & Diu Civil Services, Group B ; (xxvi) Delhi and Andaman & Nicobar Islands Police Service, Group B , (xxvii) Pondicherry Police Service, Group B ; (xxviii) Goa, Daman and Diu Police Service, Group B and (xxix) Posts of Assistant Commandant, Group B in the Central Industrial Security Force, is held by the Union Public Service Commission at 38 centres all over India including the metropolitan cities such as Ahmedabad, Bangalore, Bombay, Calcutta, Delhi, Hyderabad, Jaipur, Lucknow, Madras and Nagpur, generally in the month of June every year.

The Civil Services Examination consists of two successive stages (i) Civil Services Preliminary Examination (Objective type) for the selection of candidates for the Main Examination and (ii) Civil Services Main Examination (Written and Interview) for the selection of candidates for the various services and posts mentioned above.

The Preliminary Examination consists of two papers of objective type. This examination is meant to serve as a screening test only ; the marks obtained in the Preliminary Examination by the candidates who are declared qualified for admission to the Main Examination are not counted for determining their final order of Merit. Only those candidates who are declared by the commission to have qualified in the Preliminary Examination in a year, are eligible for admission to the Main Examination of that year provided they are otherwise eligible for admission to the Main Examination. The main Examination consists of a written examination and an interview test.

The Preliminary Examination consists of two papers : *Paper I* : General Studies and *Paper II* : One optional subject to be selected out of (i) Agriculture (ii) Animal Husbandary and Veterinary Sciences ; (iii) Botany ; (iv) Chemistry ; (v) Civil Engineering ; (vi) Commerce ; (vii) Economics ; (viii) Electrical Engineering ; (ix) Geography ; (xi) Indian History ; (xii) Law ; (xiii) Mathematics ; (xiv) Mechanical Engineering ; (xv) Philosophy ; (xvi) Physics ; (xvii) Political Science ; (xviii) Psychology ; (xix) Public Administration ; (xx) Sociology ; (xxi) Statistics and (xxii) Zoology. Both the papers are of objective type and consist of multiple choice questions only.

The purpose of this book is to make the reader aware of what he is expected to know and what type of questions he might come across while appearing at the Preliminary Examination. I trust the questions framed in this book will help him a lot in understanding, learning and analysing the various concepts involved and at the same time prepare him for the Main Examination as well. An effort has been made to cover all the topics in detail as per prescribed syllabus for the Preliminary Examination.

This book contains approximately 1500 objective type questions (multiple choice) divided into seven chapters such as : Chapter I : Algebra (Development of Number Systems and Theory of Equations), Chapter II : Matrices, Chapter III : Calculus (Differential and Integral including Convergency and Divergency of an Infinite Series), Chapter IV : Differential Equations, Chapter V : Geometry (Two and Three Dimentional), Chapter VI : Vector Algebra and Chapter VII : Mechanics.

I am indebted to Shri S. K. Sachdeva, Editor, Competition Success Review for inspiring me in the preparation of this manuscript. I express my sincere thanks to Dr. Kanti Swarup, Professor of Operations Research, Indian Institute of Public Administration, New Delhi for going through the manuscript and making many useful suggestions. Finally, to my wife Kumud, I owe many thanks for her encouragement and forbearance. Needless to say, I alone must take full responsibility for the errors and shortcomings of this book.

Suggestions, if any, for the improvement of this book will be gratefully acknowledged and welcomed.

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SYLLABUS

MATHEMATICS (Code No. 12)

Algebra : Development of number systems, natural numbers, integers, rational numbers, real and complex numbers, division algorithm, greatest common divisor, polynomials, Division algorithm, derivations, integral, rational, real and complex roots of a polynomial, relations between roots and coefficients, repeated roots, elementary symmetric functions, numerical methods of solutions of algebraic equations, cubic and the quartic (Cardan's method).

Matrices : Addition and multiplications, elementary row and column operations, rank, determinants, solutions of systems of linear equations.

Calculus : Real numbers, order completeness property, standard functions, limits continuity, properties of continuous functions in closed intervals, differentiability, Mean Value Theorem, Taylor's Theorem, maxima and minima, Application to curves—tangent normal properties, curvature, asymptotes, double points, points of inflexion and tracing.

Definition of a definite integral of a continuous function as the limit of a sum, fundamental theorem of integral calculus, methods of integration, rectification, quadrature, volume and surfaces of solids of revolution.

Partial differentiation and its applications, Double and Triple Integration, Application to area, volume, centre of mass, moment of inertia etc., Simple tests of convergence of series of positive terms, alternating series and absolute convergence

Differential Equations : First order differential equations, Singular solutions, geometrical interpretations; linear differential equations with constant coefficients.

Geometry : Analytical Geometry of straight lines and conics referred to cartesian and polar coordinates; Three dimensional geometry for planes, straight lines, sphere and cone.

Mechanics : Concept of particle, lamina, rigid body, displacement, force, mass, weight; concept of scalar and vector quantities, vector algebra, combination and equilibrium of coplanar forces, Newton's laws of motion, limitations of newtonian mechanics, motion of a particle in a straight line and on a plane.

Section - A

DEVELOPMENT OF NUMBER SYSTEMS

1. Which one of the following is not a Peano's axiom for the set N of natural numbers :

(a) There exists a natural number 1 ☐

(b) There exists an injective mapping $\sigma : N \rightarrow N$. If $n \in N$, then ☐

$\sigma(n)$ is called the successor of n

(c) σ is an onto mapping ☐

(d) If $K \subseteq N$ such that $1 \in K$ and ☐

$n \in K \Rightarrow \sigma(n) \in K$, then $K = N$ ☐

2. Giuseppe Peano, whose name is associated with the axioms for natural numbers, was

(a) An American mathematician ☐

(b) A French mathematician ☐

(c) A German mathematician ☐

(d) An Italian mathematician ☐

3. Which is not a meaningful statement in N , the set of natural numbers

If '+' denotes the addition operation and ' $\cdot$ ' denotes the multiplication operation on N , then

(a) $a+0=a \forall a \in N$ ☐

(b) $a+(b+c)=(a+b)+c \forall a, b, c \in N$ ☐

(c) $a+b=b+a \forall a, b \in N$ ☐

(d) $a \cdot (b+c)=a \cdot b+a \cdot c \forall a, b, c \in N$ ☐

4. Mark the false statement :

(a) $a \leq b$ and $c \leq d \Rightarrow ac \leq bd$ ☐
 $\forall a, b, c, d \in N$

(b) $a \leq b$ and $c < d \Rightarrow ac < bd$

$\forall a, b, c, d \in N$ ☐

(c) $a < b$ and $c < d \Rightarrow ac < bd$

$\forall a, b, c, d \in N$ ☐

(d) None of the above statements is

true ☐

5. Which one the following is the axiom of mathematical induction for the set N of natural numbers

(a) There exists a natural number 1 ☐

(b) The number 1 is not a successor of any natural number; ☐

(c) If $K \subseteq N$ such that $1 \in K$, and $n \in K \Rightarrow \sigma(n) \in K$, then $K = N$ ☐

(d) None of the above ☐

6. Which is a meaningful statement ?

(a) $x^2+5x+6=0$ has a solution in N , the set of natural numbers ☐

(b) $x^2-5=0$ has a solution in Z , the set of all integers ☐

(c) $x^2-3x+2=0$ has a solution in N ☐

(d) All the statements (a), (b), (c) are meaningless. ☐

7. Mark the incorrect statement :

(a) $a(b+c)=ab+ac \forall a, b, c \in Z$ ☐

(b) $ac=bc \Rightarrow a=b$ for all $a, b, c \in Z$ ☐

(c) $(a+b)(a-b)=a^2-b^2 \forall a, b \in Z$ ☐

(d) At least one of the above statements is not correct ☐

8. Mark the incorrect statement

(a) $x \cdot 0 = 0 \forall x \in \mathbb{Z}$, the set of integers ☐

(b) $x \cdot 1 = 1 \forall x \in \mathbb{Z}$ ☐

(c) $(-x) \cdot (-y) = x \cdot y \forall x, y \in \mathbb{Z}$ ☐

(d) $x \cdot (-y) = -(x \cdot y) \forall x, y \in \mathbb{Z}$ ☐

9. Let $|a|$ denote the absolute value of $a \in \mathbb{Z}$, the set of integers. Then mark the incorrect statement

(a) $|a| = |-a|$ ☐

(b) $|ab| = |a| |b|$ ☐

(c) $|a+b| \leq |a| + |b|$ ☐

(d) $|a-b| \leq |a| - |b|$ ☐

10. Which of the following is not a prime number

(a) 1 ☐

(b) 17 ☐

(c) 29 ☐

(d) 37 ☐

11. Mark the incorrect statement

Let a, b be any two integers and d be the g.c.d. of a and b . Then

(a) $d | a$ and $d | b$ ☐

(b) $c | a, c | b \Rightarrow c | d$ ☐

(c) $c | a, c | b$ and $c \in \mathbb{N} \Rightarrow c \leq d$ ☐

(d) $c | a$ and $c | b \Rightarrow c > d$ ☐

12. Mark the incorrect statement :

Let Q be the set of all rational numbers. Then

(a) $x + (y + z) = (x + y) + z \forall x, y, z \in Q$ ☐

(b) $\exists 0 \in Q$ such that $x + 0 = x = 0 + x$ for all $x \in Q$ ☐

(c) For each $x \in Q, \exists y \in Q$ such that $x + y = 0 = y + x$ ☐

(d) $(x_1 + x_2) + (x_3 + x_4)$ and $x_1 + \{x_2 + (x_3 + x_4)\}$ may or may not be equal where $x_1, x_2, x_3, x_4 \in Q$ ☐

13. If x and y are two positive rational numbers, then $\exists$ a positive integer x such that $xy > x$. This property is known as

(a) Archimedean property ☐

(b) Division algorithm ☐

(c) Unique factorization theorem ☐

(d) Euclid's algorithm ☐

14. Let n be any integer such that $|n| > 1$. Then n is expressible as a product of a unit and finitely many prime numbers. Moreover, such an expression is unique except as to the order in which the various factors occur. This property is known as

(a) Archimedean property ☐

(b) Division algorithm ☐

(c) Unique factorization theorem ☐

(d) Euclid's algorithm ☐

15. Given two integers a and b ($b \neq 0$), there exists unique integers q and r such that

$$a = bq + r, 0 \leq r < |b|$$

This is known as

(a) Euclid's algorithm ☐

(b) Division algorithm; ☐

(c) Archimedean property; ☐

(d) None of the above ☐

16. Which one of the following subsets of Q , the set of rational numbers is bounded above

(a) $\mathbb{Z}$, the set of all integers; ☐

(b) $\mathbb{Z}^+$, the set of positive integers; ☐

(c) $\mathbb{Z}^-$, the set of negative integers ☐

(d) $\mathbb{Z}^+ \cup \{0\}$, the set of non-negative integers ☐

17. If for a set S of rational numbers, there exist a rational number u such that $x \leq u$ for all $x \in S$, then the set S is said to be

(a) Bounded below ☐

(b) Bounded above ☐

(c) Neither bounded above, nor bounded below ☐

(d) None of the above ☐

18. There exists no rational number whose square is

(a) 61 ☐(b) 64 ☐(c) 121 ☐(d) 169 ☐

19. Which is a correct statement? If R is any set of real numbers, then

(a) For each real number x , either $x \geq 0$ or $x \leq 0$ ☐

(b) If x and y are non-negative real numbers, then xy is positive ☐

(c) If x is a positive real number, then $x-y$ is positive for all $y \in R$. ☐

(d) If x is positive and y is negative, then xy is positive for all $x, y \in R$ ☐

20. Mark the incorrect statement :
If A is a non-empty subset of R , then

(a) A may or may not be bounded above ☐

(b) If A is bounded above, it must have a least upper bound ☐

(c) If A is bounded below, it must have a greatest lower bound ☐

(d) A is bounded above iff $R-A$ is bounded below ☐

21. Mark the incorrect statement :

(a) $(a+b)+c=a+(b+c)$ for all $a, b, c \in Z$ ☐

(b) $a+b=0 \Rightarrow b \in Z$, for all $a \in Z$ ☐

(c) $a+0=a=0+a$, for all $a \in Z$ ☐

(d) $a+b=0 \Rightarrow$ Either $a=0$ or $b=0$, $\forall a, b \in Z$ ☐

22. Mark the incorrect statement :

(a) $ab=1 \Rightarrow a=b \forall a, b \in Z$ ☐

(b) $ab=1 \Rightarrow a \in Z$ and $b \in Z$ ☐

(c) $ab=ba \forall a, b \in Z$ ☐

(d) $a.1 = 1.a \forall a \in Z$ ☐

23. Mark the incorrect statement :

(a) $x=y$ if $x.z=y.z$ for some $z \in Z$ ☐

(b) $x=y \Rightarrow x.z=y.z$ for all ☐

$x, y, z \in Z$ ☐

(c) $x.y=0 \Rightarrow$ either $x=0$ or $y=0$, $\forall x, y \in Z$ ☐

(d) $-(-x)=x \forall x \in Z$ ☐

24. Mark the incorrect statement :
If $a \in Z$, then $|a|$ is equal to

(a) a if $a \geq 0$ ☐

(b) $-a$ if $a < 0$ ☐

(c) Any square root of a^2 ☐

(d) $|-a|$ ☐

25. Mark the incorrect statement :
If $b > 0$, then

(a) $a.b < 0$ iff $a < 0$ ☐

(b) $a.b > 0$ iff $a > 0$ ☐

(c) $a^2 > b^2$ iff $a > b$ ☐

(d) $a^2 > b^2$ iff $a > b$ or $a < -b$ ☐

26. If p is a positive integer, then p is equal to

(a) 1 ☐

(b) A prime number ☐

(c) A composite number ☐

(d) Exactly one of (a), (b) and (c) ☐

27. Let $P(x)$ be a property which is either true or false for every $x \in N$. If $P(r)$ is true for all $r < k \Rightarrow P(k)$ is true, then $P(k)$ is true for all $k \in N$. This refers to

(a) First principle of finite induction ☐

(b) Second principle of induction ☐

(c) Well ordering principle ☐

(d) None of the above ☐

28. The well ordering principle is equivalent to :

(a) Addition property of order ☐

(b) Multiplication property of order ☐

(c) Principle of finite induction ☐

(d) None of the above ☐

29. If $S \subset N$ and $l \in S$, such that $l \leq s \forall s \in S$, then l is called :

(a) The least element of S ☐

(b) The greatest element of S ☐

(c) Both of (a) and (b) ☐

(d) None of the above ☐

30. Every non empty subset of natural numbers has a least element. This statement refers to :

- (a) The law of symmetry ☐
 (b) The well ordering principle ☐
 (c) The law of transitivity ☐
 (d) None of the above ☐

31. If $m, n \in N$, then one and only one of the following is true :

$m=n$, $m>n$, or $n>m$, This statement refers to :

- (a) The law of transitivity ☐
 (b) The well ordering principle ☐
 (c) The law of trichotomy ☐
 (d) None of the above ☐

32. If $m, n \in N$, such that $m>n \Rightarrow m+p>n+p$, for all $p \in N$. This refers to :

- (a) Addition property of order ☐
 (b) Subtraction property of order ☐
 (c) Both of the above ☐
 (d) None of the above ☐

33. The binary operation called 'multiplication in N ' to be denoted by ' $\cdot$ ' is defined if :

- (a) $m \cdot 1 = m \quad \forall m \in N$ ☐
 (b) $m \cdot n' = m \cdot n + m \quad \forall m, n \in N$ and where n' is called the successor of n ☐
 (c) Atleast one of (a) and (b) holds good ☐
 (d) Both of (a) and (b) hold good. ☐

34. If $m, n, p \in N$, the set of natural numbers, then $m>n$ and $n>p \Rightarrow m>p$. This is called :

- (a) Law of transitivity ☐
 (b) Law of reflexivity ☐
 (c) Law of symmetry ☐
 (d) Well ordering principle ☐

35. Mark the incorrect statement :
 The set of real numbers possesses the completeness property $\Rightarrow$

(a) Any non empty subset of R , which is bounded above has a least upper bound ☐

(b) Any non empty subset of R , which is bounded below has a greatest lower bound ☐

(c) At least one of (a) and (b) ☐

(d) Both of (a) and (b) ☐

36. In N , how many elements are non-successors ?

- (a) 1 ☐
 (b) 2 ☐
 (c) ∞ ☐
 (d) Cannot be said ☐

37. The binary operation called 'addition in N ' to be denoted by ' $+$ ' is defined if :

- (a) $m+1=m' \quad \forall m \in N$, where m' is called the successor of m ☐
 (b) $m+n'=(m+n)' \quad \forall m, n \in N$ ☐
 (c) Atleast one of (a) and (b) ☐
 (d) Both of (a) and (b) ☐

38. Mark the incorrect statement

- (a) If $x, y \in R$ and $x, y > 0$, then $\exists n \in N$ such that $nx > y$ ☐
 (b) If $x, y \in R$ and $x < y$, then there exists $z \in R$ such that $x < z < y$ ☐
 (c) $x^2 = |x|^2 \quad \forall x \in R$ ☐
 (d) $x^2 > 0, \quad \forall x \in R$ ☐

39. Mark the incorrect statement :
 If A is a non empty bounded subset of R and let k be its least upper bound, then

- (a) $x \leq k \quad \forall x \in A$ ☐
 (b) $x < k \quad \forall x \in A$ ☐
 (c) For each $\epsilon > 0, \exists x \in A$ such that $x > k - \epsilon$ ☐
 (d) If $x \leq p \quad \forall x \in A$, then $k \leq p$ ☐

40. Which one of the following is a false statement ?

- (a) $x(y+z) = xy + xz \quad \forall x, y \in R$, the set of real numbers ☐
 (b) $(xy+z) = (x+z) \cdot (y+z)$ in R only if $z=0$ ☐

- (c) $\exists 1 \in R$ such that $x.1 = x = 1.x$, $\forall x \in R$ ☐
- (d) For each $x (\neq 0) \in R$, there exists $y \in R$ such that $x.y = 1 = y.x$ ☐
41. Mark the meaningless statement :
- (a) $a < b \Rightarrow ac < bc$, $\forall a, b \in R$ and $c \in R^+$, the set of all positive real numbers ☐
- (b) $a < b \Rightarrow a/c > b/c$, $\forall a, b \in R$ and $c \in R^-$, the set of all negative real numbers ☐
- (c) $a \leq b \Rightarrow ac \leq bc$ $\forall a, b, c \in R$ ☐
- (d) $a \leq b \Rightarrow a + c \leq b + c$ $\forall a, b, c \in R$ ☐
42. Mark the incorrect statement :
- (a) Q , the set of rational numbers is complete ordered field ☐
- (b) If $x, y \in Q$ and $x < y$, then $\exists z \in Q$ such that $x < z < y$ ☐
- (c) For each negative rational number y , $\exists$ a negative integer m such that $m < y$ ☐
- (d) There is no $q \in Q$ such that $q^2 = 2$ ☐
43. The subset N of Q is
- (a) Bounded above, but not bounded below ☐
- (b) Bounded below as well as bounded above ☐
- (c) Not bounded above, is bounded below but does not have a greatest lower bound ☐
- (d) Bounded below, but not bounded above ☐
44. Let $a, b \in Z$, the set of integers and d be the g.c.d. of a and b . Mark the incorrect statement
- (a) $d \neq 0$ ☐
- (b) If $d = am + bn$, m and n need not be nonzero ☐
- (c) There exist unique m and $n \in Z$ such that $d = am + bn$ ☐
- (d) There exist m and $n \in Z$ such that $d = am + bn$ ☐
45. Which one of the following is not a correct statement :
- (a) If the only divisors of p are ± 1 and $\pm p$, then p is prime number ☐
- (b) If p is a prime number, then $p > 1$ ☐
- (c) If p is a composite number, then it has atleast one divisor other than ± 1 and $\pm p$ ☐
- (d) If p is a composite number, then $p > 1$ ☐
46. A relation is said to be an *Equivalence Relation* if
- (a) It is reflexive and symmetric ☐
- (b) It is reflexive and transitive ☐
- (c) It is symmetric and transitive ☐
- (d) It is reflexive, symmetric and transitive ☐
47. The relation $\sim$ in $N \times N$, such that $(a, b) \sim (c, d)$ iff $a + d = b + c$, is
- (a) Neither symmetric nor transitive but reflexive ☐
- (b) Reflexive and transitive but not symmetric ☐
- (c) An equivalence relation ☐
- (d) None of the above ☐
48. If p and q are integers such that $p \cdot q = 0$, then it is necessary that :
- (a) $p = 0$ ☐
- (b) $q = 0$ ☐
- (c) At least one of p and q must be zero ☐
- (d) Both of p and q must be zero ☐
49. If a and b are integers, then the equation $a \cdot x = b (a \neq 0)$:
- (a) Always has a solution in Z ☐
- (b) Never has a solution in Z ☐
- (c) Sometimes has a solution in Z and sometimes not ☐
- (d) None of the above ☐
50. R. Dedekind, whose name is associated with the Dedekind-cut was

- (a) An American Mathematician ☐ (c) U_1 has a least element ☐
 (b) A French Mathematician ☐ (d) L_1 has a greatest element ☐
 (c) A German Mathematician ☐
 (d) An Italian Mathematician ☐
51. Dedekind-cut is called a ☐
 (a) Rational number ☐
 (b) Real number ☐
 (c) Complex number ☐
 (d) None of the above ☐
52. Dedekind-cut is an ordered pair of subsets of the set of ☐
 (a) Integers ☐
 (b) Natural numbers ☐
 (c) Rational numbers ☐
 (d) Irrational numbers ☐
53. Let Q be the set of rational numbers and let L and U be its proper, disjoint and non-empty subsets. Then the ordered pair (L, U) is called a **real number** or **Dedekind Cut** if ☐
 (a) $a \in Q \wedge a < b$ for some $b \in L \Rightarrow a \in L$ i.e. every rational number less than a member of L is a member of L ☐
 (b) $a \in L \Rightarrow \exists a' \in L$ such that $a' > a$ i.e. L has no greatest element ☐
 (c) At least one of (a) and (b) holds ☐
 (d) Both of (a) and (b) hold ☐
54. Let $L_1 = \left\{ x \in Q \mid x < \frac{2}{5} \right\}$ be a proper non empty subset of Q . Then L_1 ☐
 (a) Has a greatest member ☐
 (b) Has no greatest member ☐
 (c) May or may not have a greatest member ☐
 (d) Insufficient information to predict ☐
55. Let (L_1, U_1) be any real number where L_1 and U_1 are nonempty proper subsets of the set of rational numbers. Then (L_1, U_1) is called a **real rational number** if ☐
 (a) U_1 has no least element ☐
 (b) L_1 has no greatest element ☐
- (c) U_1 has a least element ☐
 (d) L_1 has a greatest element ☐
56. If (L, U) is a Dedekind Cut, then $x, y \in Q$ such that $x \in L$ and $y \in U \Rightarrow$ ☐
 (a) $x > y$ ☐
 (b) $x = y$ ☐
 (c) $x < y$ ☐
 (d) (a) and (b) or (c) and (b) ☐
57. $\sqrt{-1}$ is ☐
 (a) An irrational number ☐
 (b) A real number but not irrational ☐
 (c) A complex number ☐
 (d) None of the above ☐
58. The name of the first mathematician to use the symbol i for $\sqrt{-1}$ was ☐
 (a) R. Dedekind ☐
 (b) K. F. Gauss ☐
 (c) Euler ☐
 (d) None of the above ☐
59. A complex number z is defined to be an ordered pair of ☐
 (a) Integers ☐
 (b) Rational numbers ☐
 (c) Irrational numbers ☐
 (d) Real numbers ☐
60. Let c be any set of complex numbers. Let for any $z = (a, b)$ in C , $z \cdot z' = z$. Then z' is equal to: ☐
 (a) $(0, 0)$ ☐
 (b) $(0, 1)$ ☐
 (c) $(1, 0)$ ☐
 (d) $(1, 1)$ ☐
61. Let C be any set of complex numbers. Let for any $z = (a, b) \in C$, $z + z' = z$. Then z' is equal to ☐
 (a) $(0, 0)$ ☐
 (b) $(0, 1)$ ☐
 (c) $(1, 0)$ ☐
 (d) $(1, 1)$ ☐
62. If (a, b) and (c, d) be any two complex numbers, then $(a, b) \cdot (c, d)$ is equal to ☐

- (a) $(ac+bd, ad+bc)$ ☐
 (b) $(ac-bd, ad-bc)$ ☐
 (c) $(ac+bd, ad-bc)$ ☐
 (d) $(ac-bd, ad+bc)$ ☐

63. Let $z=(2, 3)$ and $z'=(-1, 4)$ be any two complex numbers, then $zz' =$

- (a) $(14, 5)$ ☐
 (b) $(-14, +5)$ ☐
 (c) $(5, 14)$ ☐
 (d) $(-5, 14)$ ☐

64. Let $z=(2, 3)$ be any complex number. Then inverse of z with respect to multiplication is given by

- (a) $\left(\frac{2}{13}, \frac{3}{13}\right)$ ☐
 (b) $\left(\frac{2}{5}, \frac{3}{5}\right)$ ☐
 (c) $\left(\frac{2}{13}, -\frac{3}{13}\right)$ ☐
 (d) $\left(\frac{2}{5}, -\frac{3}{5}\right)$ ☐

65. The sum of two conjugate complex members is

- (a) Always real ☐
 (b) May or may not be real ☐
 (c) Always imaginary ☐
 (d) May or may not be imaginary ☐

66. The difference of two conjugate complex numbers is

- (a) Purely real ☐
 (b) Purely imaginary ☐
 (c) Either real or imaginary ☐
 (d) At least one of (a), (b), (c) ☐

67. If $z=a+ib$ is any complex number, then we define

$a = \text{Real part of } z = R(z) \text{ and}$
 $b = \text{Imaginary part of } z = I(z).$

If z_1 and z_2 are any two complex numbers, then $R(z_1 z_2) =$

- (a) $R(z_1) \cdot R(z_2)$ ☐

- (b) $R(z_1) \cdot I(z_2)$ ☐
 (c) $I(z_1) \cdot R(z_2)$ ☐
 (d) None of the above ☐

68. If $z=a+ib$ is any complex number, then modulus of z or absolute value of z or $|z|$ is equal to

- (a) a^2+b^2 ☐
 (b) $\sqrt{a^2+b^2}$ ☐
 (c) $-(a^2+b^2)$ ☐
 (d) $-\sqrt{a^2+b^2}$ ☐

69. If $z=a+ib$ is any complex number, then argument (or amplitude) of z is equal to

- (a) $\frac{b}{a}$ ☐
 (b) $\frac{a}{b}$ ☐
 (c) $\tan^{-1} \frac{b}{a}$ ☐
 (d) $\tan^{-1} \frac{a}{b}$ ☐

70. Let θ denote the argument of the complex number z . Then principal value of θ lies between

- (a) $-\frac{\pi}{2}$ and $\frac{\pi}{2}$ ☐
 (b) $-\frac{\pi}{4}$ and $\frac{\pi}{4}$ ☐
 (c) $-\pi$ and π ☐
 (d) None of the above ☐

71. The modulus and the principal argument of the complex number $-3i$, are respectively

- (a) 3 and $\frac{\pi}{2}$ ☐
 (b) 3 and $-\frac{\pi}{2}$ ☐
 (c) -3 and $\frac{\pi}{2}$ ☐
 (d) -3 and $-\frac{\pi}{2}$ ☐

72. Which one of the following is a meaningful statement? If z, z_1, z_2 are any complex numbers, then

- (a) $|z_1 - z_2| \leq |z_1| - |z_2|$ ☐
 (b) $|z_1 - z_2| \leq ||z_1| - |z_2||$ ☐
 (c) $-|z| \leq R(z) \leq |z|$ ☐
 (d) $|z_1 z_2| > |z_1| |z_2|$ ☐

73. Mark the incorrect choice: There exists a one-to-one correspondence between the set of all complex numbers and the set of all points on a plane which is called the

- (a) Gauss plane or ☐
 (b) Cauchy plane or ☐
 (c) Argand plane or ☐
 (d) Euler plane. ☐

74. Mark the correct statement:

- (a) The x -axis is the locus of the images of imaginary numbers ☐
 (b) The y -axis is the locus of the images of real numbers ☐
 (c) The image of $-z$ is the point symmetric to the image of z with respect to the x -axis ☐
 (d) None of the above. ☐

75. Mark the correct statement: In the Argand plane of complex numbers

- (a) The image of the number $\bar{z}$ is the point symmetric to the image of z with respect to the y -axis ☐
 (b) The image of the number $-\bar{z}$ is the point symmetric to the image of z , with respect to the x -axis ☐
 (c) The image of $-z$ is the point symmetric to the image of z with respect to the origin O ☐
 (d) None of the above. ☐

76. Mark the correct statement:

- (a) $a \leq b$ and $c \leq d \Rightarrow a - c \leq b - d$
 $\forall a, b, c, d \in \mathbb{N}$ ☐
 (b) $a \leq b$ and $c \leq d \Rightarrow a - d \leq b - c$
 $\forall a, b, c, d \in \mathbb{N}$ ☐

$$(c) a < b \text{ and } c < d \Rightarrow a - c < b - d$$

$$\forall a, b, c, d \in \mathbb{N} \quad \square$$

- (d) None of the above statements is correct. ☐

77. Let a, b be any two elements of $\mathbb{Z}$, the set of integers. Mark the correct statement:

- (a) $a > b$ ☐
 (b) $a > b$ ☐
 (c) $a = b$ ☐
 (d) One of (a), (b) and (c) holds. ☐

78. Let a, b be any two elements of $\mathbb{Z}$, the set of integers. Mark the incorrect statement:

- (a) $ab > 0$ if $a > 0$ and $b > 0$ ☐
 (b) $ab > 0$ only if $a < 0$ and $b < 0$ ☐
 (c) $ab > 0$ only if $a < 0$ and $b < 0$ or $a > 0$ and $b > 0$ ☐
 (d) $ab > 0$ only if a and b are of the same sign. ☐

79. Which of the following is a prime integer?

- (a) 0 ☐
 (b) 1 ☐
 (c) 2 ☐
 (d) -3 ☐

80. Mark the incorrect statement: Let $x, y, z \in \mathbb{Q}$ be any three rational numbers. Then

- (a) $x > y$ and $y > z \Rightarrow x > z$ ☐
 (b) $x > y \Rightarrow x + z > y + z \forall z \in \mathbb{Q}$ ☐
 (c) $xc > yc \Rightarrow x > y$ and $c > 0$ ☐
 (d) $x > y$ and $c > 0 \Rightarrow xc > yc$ ☐

81. Between any two distinct rational numbers, there exists another rational number. This property is known as

- (a) Division Algorithm ☐
 (b) Density of rational numbers ☐
 (c) Euclid's Algorithm ☐
 (d) None of the above. ☐

82. Mark the wrong statement: Let R be the set of real numbers. Then

(a) $x + (y + z) = (x + y) + z, \forall$
 $x, y, z \in R$ ☐

(b) $x + y = y + x \forall x, y \in R$ ☐

(c) $\exists 0 \in R$ such that
 $x + 0 = x = 0 + x \forall x \in R$ ☐

(d) To each real number x , $\exists$ atleast
 one real number y such that
 $x + y = 0 = y + x.$ ☐

83. Mark the correct statement :

(a) Every real number is either a positive integer or zero or a negative integer ☐

(b) Every real number is a rational number ☐

(c) Every real number is an irrational number ☐

(d) Every real number is either a rational number or an irrational number ☐

84. Mark the statement which is not meaningful :

If N is any set of natural numbers and $\cdot$ denotes the multiplication operation on N , then

(a) $a \cdot b = b \cdot a$, for all $a, b \in N$ ☐

(b) $a \cdot 1 = a$, for all $a \in N$ ☐

(c) $a \cdot 0 = 0$, for all $a \in N$ ☐

(d) $a \cdot (b \cdot c) = (a \cdot b) \cdot c \forall a, b, c \in N$ ☐

85. If m and n are any two natural numbers, then

(a) $m = n$ ☐

(b) $m = n + p$ for some $p \in N$ ☐

(c) $n = m + p$ for some $p \in N$ ☐

(d) One of (a), (b) and (c) holds ☐

86. Mark the incorrect statement :

(a) $a^m \cdot a^n = a^{m+n} \forall a, m, n \in N$ ☐

(b) $a^m \cdot b^m = (a \cdot b)^m \forall a, b, m \in N$ ☐

(c) $(a^m)^n = a^{mn} \forall a, m, n \in N$ ☐

(d) $a^m + b^m = (a + b)^m \forall a, b, m \in N$ ☐

87. Mark the incorrect statement :

(a) $\exists$ a unique element $1 \in Z$ such that $x \cdot 1 = x = 1 \cdot x \forall x \in Z$ ☐

(b) $\exists$ a unique element $0 \in Z$ such that $x + 0 = x = 0 + x \forall x \in Z$ ☐

(c) $\exists$ a unique $y \in Z$ such that $x \cdot y = 1 = y \cdot x \forall x \in Z$ ☐

(d) At least one of (a), (b) and (c) does not hold ☐

88. Mark the incorrect statement :

(a) $(a + b) + c = a + (b + c)$
 $\forall a, b, c \in Z$ ☐

(b) $(a + b) - c = a + (b - c)$
 $\forall a, b, c \in Z$ ☐

(c) $(a - b) + c = a - (b + c)$
 $\forall a, b, c \in Z$ ☐

(d) $(a - b) - c = a - (b + c)$
 $\forall a, b, c \in Z$ ☐

89. If $a, b \in Z$, then

(a) $a > b$ ☐

(b) $a < b$ ☐

(c) $a = b$ ☐

(d) One of (a), (b) and (c) holds ☐

90. Mark the incorrect statement :

If $a, b, c \in Z$ be any three elements, then

(a) $a > b$ and $b > c \Rightarrow a > c$ ☐

(b) $a > b \Rightarrow a + c > b + c$ ☐

(c) $a > b \Rightarrow ac > bc$ ☐

(d) $a > b$ and $c < 0 \Rightarrow ac < bc$ ☐

91. Mark the incorrect statement ;

If $a, b, c \in Z$, then

(a) $ab > 0$ iff $a > 0$ and $b > 0$ ☐

(b) $a > b$ iff $c - a < c - b$ ☐

(c) $a > b$ iff $a - c > b - c$ ☐

(d) $a > b$ iff $ac > bc$ for all $c > 0$ ☐

92. Mark the incorrect statement :

(a) If a divides b , then b divides a ☐

(b) If a divides b , then $-a$ also divides b ☐

(c) 1 and -1 divide every integer ☐

(d) Every integer divides 0. ☐

93. If N is the set of natural numbers, then $m > n$, if $\exists u \in N$ such that

(a) $m = n + u$ ☐

(b) $n = m + u$ ☐

(c) Both of (a) and (b) holds ☐

(d) None of (a) and (b) holds ☐

94. Let A and B be two non empty subsets of R such that A is bounded above and B is bounded below.

Mark the incorrect statement :

(a) $A \cap B$ is bounded ☐

(b) $A - B$ is bounded above ☐

(c) $A \cup B$ is bounded ☐

(d) $B - A$ is bounded below ☐

95. If Q is the set of all rational numbers, then find out the incorrect statement :

(a) $x(y-z) = xy - xz \quad \forall x, y, z \in Q$ ☐

(b) $(x-y)z = xz - yz \quad \forall x, y, z \in Q$ ☐

(c) Addition in Q distributes over multiplication in Q ☐

(d) Multiplication in Q distributes over addition in Q ☐

96. Mark the incorrect statement :

(a) $x \cdot 0 = 0 \quad \forall x \in Q$ ☐

(b) $x = y \Rightarrow \frac{x}{z} = \frac{y}{z}, \quad \forall x, y, z \in Q$

and $z \neq 0$ ☐

(c) $\frac{x}{y} = \frac{y}{z} \Rightarrow x = y$ for all $x, y, z \in Q$

such that $z \neq 0$ ☐

(d) $xz = yz \Rightarrow x = y \quad \forall x, y, z \in Q$ ☐

97. Let Q be the set of rational numbers. Which one of the following statements is wrong ?

(a) $x(yz) = (xy)z \quad \forall x, y, z \in Q$ ☐

(b) For each $x \in Q$, $\exists$ a nonzero $y \in Q$ such that $xy = yx = 1$ ☐

(c) $xy = yx \quad \forall x, y \in Q$ ☐

(d) $\exists 1 \in Q$ such that $x \cdot 1 = 1 \cdot x = x \quad \forall x \in Q$ ☐

98. If a, b be any two integers with $b \neq 0$, then there exist integers q, r such that $a = bq + r$, $0 \leq r < |b|$, then

(a) q is unique but r need not be unique ☐

(b) r is unique but q need not be unique ☐

(c) None of q and r is unique ☐

(d) Both q and r are unique ☐

99. If $m, n \in N$, such that $m \leq n \leq m+1$, then

(a) $m = n$ ☐

(b) $m+1 = n$ ☐

(c) Only one of (a) and (b) ☐

(d) Both of (a) and (b) ☐

100. Let Z be the set of all integers. Let p, q be any two elements in Z . Then the equation $x + p = q$ has

(a) A unique solution in Z ☐

(b) More than one but a finite number of solutions in Z ☐

(c) No solution in Z ☐

(d) None of the above ☐

101. Let $z = a + ib$ be any complex number where a and b are any real numbers, then

(a) $z = (b, a)$ ☐

(b) $z = (a, b)$ ☐

(c) $z = (-a, b)$ ☐

(d) $z = (a, -b)$ ☐

102. The complex conjugate of $x+iy$ is :

- (a) $x+iy$ ☐
 (b) $-x+iy$ ☐
 (c) $x-iy$ ☐
 (d) $-x-iy$ ☐

103. The product of two conjugate complex numbers is

- (a) A real rational number ☐
 (b) A complex number ☐
 (c) A real irrational number ☐
 (d) None of the above ☐

104. The modulus and the principal argument of the complex number $\frac{1+2i}{1-(1-i)^2}$ are respectively :

- (a) 0 and 1 ☐
 (b) 0 and $--1$ ☐
 (c) 1 and 0 ☐
 (d) -1 and 0 ☐

105. The necessary and sufficient condition that the points Z_1, Z_2, Z_3 representing the numbers z_1, z_2, z_3 respectively on the Argand plane be the vertices of an equilateral triangle is that

- (a) $\frac{1}{z_1-z_2} = \frac{1}{z_2-z_3} + \frac{1}{z_3-z_1}$ ☐
 (b) $\frac{1}{z_1-z_3} = \frac{1}{z_1-z_2} + \frac{1}{z_2-z_3}$ ☐
 (c) $\frac{1}{z_2-z_3} = \frac{1}{z_1-z_2} + \frac{1}{z_3-z_1}$ ☐
 (d) None of the above. ☐

ANSWERS

- | | | | | | |
|-------|-------|-------|--------|--------|--------|
| 1. c | 2. d | 3. a | 55. c | 56. c | 57. c |
| 4. d | 5. c | 6. c | 58. c | 59. d | 60. c |
| 7. b | 8. b | 9. d | 61. a | 62. d | 63. b |
| 10. a | 11. d | 12. d | 64. c | 65. a | 66. b |
| 13. a | 14. c | 15. b | 67. d | 68. b | 69. c |
| 16. b | 17. b | 18. a | 70. c | 71. b | 72. c |
| 19. a | 20. d | 21. d | 73. d | 74. d | 75. c |
| 22. b | 23. a | 24. c | 76. d | 77. d | 78. b |
| 25. c | 26. d | 27. b | 79. c | 80. c | 81. b |
| 28. c | 29. a | 30. b | 82. d | 83. d | 84. c |
| 31. c | 32. a | 33. d | 85. d | 86. d | 87. c |
| 34. a | 35. c | 36. a | 88. c | 89. d | 90. c |
| 37. d | 38. b | 39. b | 91. a | 92. a | 93. a |
| 40. b | 41. c | 42. a | 94. c | 95. c | 96. d |
| 43. d | 44. c | 45. a | 97. b | 98. d | 99. c |
| 46. d | 47. c | 48. c | 100. a | 101. b | 102. c |
| 49. c | 50. c | 51. b | 103. d | 104. c | 105. b |
| 52. c | 53. d | 54. b | | | |

Section—B

THEORY OF EQUATIONS

1. $\sqrt{5x^2-2x+1}$ is
 - (a) An algebraic function of x ☐
 - (b) A transcendental function of x ☐
 - (c) An integral function of x ☐
 - (d) A rational function of x ☐
2. Which of the following functions is not a transcendental function ?
 - (a) $\log x$ ☐
 - (b) a^{3x} ☐
 - (c) $\frac{ax+b}{cx+d}$ ☐
 - (d) $\tan^{-1}x$ ☐
3. The zero of the polynomial x^3+2x-i is
 - (a) 0 ☐
 - (b) -1 ☐
 - (c) i ☐
 - (d) $-i$ ☐
4. The equation $x^2 + \frac{1}{x^2} - 5 = 0$ is of degree
 - (a) 2 ☐
 - (b) -2 ☐
 - (c) 4 ☐
 - (d) Cannot be determined ☐
5. Which is not possible ? The number of real roots of the equation

$$ax^4+bx^3+cx^2+dx+e=0,$$
 where a, b, c, d, e are complex coefficients, are
 - (a) 4 ☐
 - (b) 3 ☐
 - (c) 2 ☐
 - (d) 0 ☐
6. If $a+\sqrt{b}$ is a root of the equation $f(x)=0$, then——is also a root of that equation
 - (a) $\sqrt{a+b}$ ☐
 - (b) $\sqrt{a-b}$ ☐
 - (c) $\sqrt{a}+\sqrt{b}$ ☐
 - (d) $a-\sqrt{b}$ ☐
7. If $a+ib$ is a root of the equation $f(x)=0$ with real coefficients, then——is also the root of the equation.
 - (a) $a-ib$ ☐
 - (b) $b+ai$ ☐
 - (c) $b-ai$ ☐
 - (d) $-a-ib$ ☐
8. If there exists no real quantity which when substituted for x , makes $f(x)$ vanish, then $f(x)$ is bound to be
 - (a) Positive ☐
 - (b) Negative ☐

- (c) Either positive or negative ☐
- (d) None of the above ☐
9. If $3x^3+2x^2+x+1$ is divided by $x+2$, the remainder must be
- (a) Zero ☐
- (b) 17 ☐
- (c) -17 ☐
- (d) 35 ☐
10. If a polynomial $f(x)$ is divided by $x-h$, where h is any complex number, then the remainder is equal to $f(h)$. This statement is referred by
- (a) Division Algorithm ☐
- (b) Fundamental theorem of Algebra ☐
- (c) Remainder Theorem ☐
- (d) Factor Theorem ☐
11. If h is a zero of a polynomial $f(x)$, then $x-h$ is a factor of $f(x)$. This statement is referred by
- (a) Factor Theorem ☐
- (b) Converse of Factor Theorem ☐
- (c) Division Algorithm ☐
- (d) None of the above ☐
12. The 'Fundamental Theorem of Algebra' was discovered by
- (a) G. Cardano ☐
- (b) Lodovico Ferrari ☐
- (c) Niels Henrik Abel ☐
- (d) Karl Friedrich Gauss ☐
13. The founder of the 'Fundamental Theorem of Algebra' was—mathematician
- (a) A Norwegian ☐
- (b) An Italian ☐
- (c) A German ☐
- (d) An American ☐
14. Which of the following mathematicians is known as 'Tartaglia'.
- (a) Karl Friedrich Gauss ☐
- (b) Nicolo Fontana ☐
- (c) Abel ☐
- (d) Ferrari ☐
15. If the two equations $f(x)=0$ and $\phi(x)=0$ have common roots, then those can be obtained by finding———of $f(x)$ and $\phi(x)$
- (a) H.C.F. ☐
- (b) L.C.M. ☐
- (c) Either L.C.M. or H.C.F. ☐
- (d) None of the above ☐
16. The equations $x^3-2x^2-2x+1=0$ and $x^4-7x^2+1=0$ have———of the roots common
- (a) None ☐
- (b) One ☐
- (c) Two ☐
- (d) Three ☐
17. If $\sqrt{a}+\sqrt{b}$ be one of the roots of a given equation (a and b are not perfect squares) with rational coefficients, then the lowest degree of such an equation must be
- (a) 2 ☐
- (b) 3 ☐
- (c) 4 ☐
- (d) 6 ☐
18. If $2+\sqrt{3}$ is one of the roots of the equation $x^4+2x^3-16x^2-22x+7=0$, then
- (a) All the three remaining roots are rational ☐
- (b) Two of the remaining roots are rational and one irrational ☐
- (c) One of the remaining roots is rational and two irrational ☐
- (d) All the three remaining roots are irrational. ☐

19. If $\sqrt{2} + \sqrt{3} + i$ is one of the roots of the equation $f(x)=0$ with rational coefficients, then the lowest degree of the equation $f(x)=0$ must be

- (a) 2 ☐
 (b) 4 ☐
 (c) 8 ☐
 (d) None of the above ☐

20. The real value of $(27 + \sqrt{756})^{1/3} + (27 - \sqrt{756})^{1/3}$ is

- (a) 3 ☐
 (b) 9 ☐
 (c) 27 ☐
 (d) 54 ☐

21. If one root of the equation $x^3 - 13x^2 + 15x + 189 = 0$ exceeds the other by 2, then all the three roots are

- (a) 7, 9 and 3; ☐
 (b) -7, -9 and -3; ☐
 (c) 7, 9 and -3; ☐
 (d) -7, -9 and 3 ☐

22. The roots of the equation $x^2 - 7xi - 12 = 0$ are

- (a) $3i$ and $-3i$ ☐
 (b) 3 and -4 ☐
 (c) $3i$ and $4i$ ☐
 (d) $4i$ and $-3i$ ☐

Note:— After answering Q. 22, the reader should note immediately that in an equation with complex coefficients, complex roots may not occur in conjugate pairs but in an equation with rational coefficient, it is necessary that the complex roots will always occur in conjugate pairs.

23. The roots of the equation $x^2 - (2 + \sqrt{3})x + 2\sqrt{3} = 0$ are

- (a) Both rational; ☐
 (b) Both imaginary; ☐
 (c) One rational and one irrational; ☐
 (d) Both irrational ☐

Note:— After answering Q. 23, the reader should again feel that in an equation with irrational coefficients, the irrational roots need not occur in pairs.

24. If the rational number p/q where p and q are integers prime to each other and $q \neq 0$, is a root of the equation

$$a_0x^n + a_1x^{n-1} + \dots + a_n = 0$$

where $a_0, a_1, \dots, a_n$ are integers and $a_0 \neq 0$, then

- (a) p/a_0 and q/a_n ☐
 (b) p/a_0 and p/a_n ☐
 (c) q/a_0 and q/a_n ☐
 (d) p/a_n and q/a_0 ☐

25. The rational roots of the equation $2x^3 - 3x^2 - 11x + 6 = 0$

- are ☐
 (a) 3, 1 and 6 ☐
 (b) -3, 2 and -6 ☐
 (c) 3, -2 and 6 ☐
 (d) 3, -2 and $\frac{1}{2}$ ☐

26. If α and β are real numbers and $\beta \neq 0$ and $\alpha + i\beta$ is a root of the equation

$$x^3 + qx + r = 0$$

then one of the roots of this equation must be

- (a) $-\alpha + i\beta$ ☐
 (b) 2α ☐
 (c) -2α ☐
 (d) None of the above ☐

27. If $x + ay + a^2z = a^3$,
 $x + by + b^2z = b^3$

and $x + cy + c^2z = c^3$
 then x is equal to

- (a) $a + b + c$ ☐
 (b) $-(ab + bc + ca)$ ☐
 (c) abc ☐
 (d) None of the above ☐

28. One of the roots of the equation $x(x-1)(x-2)=a(a-1)(a-2)$, is
- (a) 0 ☐
- (b) $a-1$ ☐
- (c) Also a root of $x^2+2x+3(a-1)=0$ ☐
- (d) Also a root of $x^2-(3-a)x+(a-1)(a-2)=0$ ☐
29. If $3+\sqrt{-5}$ is a root of the equation $2x^3-15x^2+46x-42=0$ then one of its other two roots is
- (a) $3/2$ ☐
- (b) $3-\sqrt{5}$ ☐
- (c) $\sqrt{5}-3$ ☐
- (d) $\sqrt{5}+3$ ☐
30. The number of real roots of the equation $x^6-7x^3+15x^2+3x-4=0$ is at the most
- (a) 0 ☐
- (b) 3 ☐
- (c) 4 ☐
- (d) 6 ☐
31. If $f(x)=2x^4-x^3-2x^2+5x-1$, then $f(x+3)$ is equal to
- (a) $2x^4+23x^3+97x^2+182x+13$ ☐
- (b) $2x^4+23x^3+97x^2+182x+130$ ☐
- (c) $2x^4+23x^3+97x^2+182x+131$ ☐
- (d) None of the above ☐
32. An equation of odd degree possesses the property that
- (a) It has atleast one imaginary root ☐
- (a) It has no imaginary root ☐
- (c) It always possesses a real root ☐
- (d) It never possesses a real root ☐
33. The equation whose roots are $-3, -1, 4$ and 5 is
- (a) $x^4-5x^3-13x^2+53x+6=0$ ☐
- (b) $x^4-5x^3-13x^2+53x+60=0$ ☐
- (c) $(x+3)(x-1)=(x-4)(x-5)$ ☐
- (d) $(x+3)(x-1)(x-4)(x-5)=0$ ☐
34. If the roots of the equation $x^3-12x^2+39x-28$ are in A.P., then the two roots of it are
- (a) 1 and 7 ☐
- (b) 2 and 5 ☐
- (c) 3 and 8 ☐
- (d) None of the above ☐
35. If the roots of the equation $x^3-12x^2+39x-28=0$ are in A.P., then which of the following form do the roots take?
- (a) a, ad, ad^2 ☐
- (b) $a+2d, a+3d, a+5d$ ☐
- (c) $a-d, a, a+d$ ☐
- (d) $\frac{a}{d}, a+d, \frac{a}{d^2}$ ☐
36. If the equation $x^3-x^2-8x+12=0$ has a double root α , then α is also the root of
- (a) $f'(x)=0$ ☐
- (b) $f''(x)=0$ ☐
- (c) $f(x)+f''(x)=0$ ☐
- (d) $f(x)+f'(x)=0$ ☐
37. The sums of similar powers of the roots of an equation can be expressed rationally in terms of the coefficients.
- This is known as ——— on the sum of the powers of the roots of an equation.
- (a) Sturm's theorem ☐
- (b) Newton's theorem ☐
- (c) Cardan's theorem ☐
- (d) Tartaglia's theorem. ☐
38. An equation of 4th degree is known as
- (a) Quartic ☐
- (b) Quintic ☐
- (c) Quantic ☐
- (d) None of the above. ☐
39. The condition that the given cubic equation $x^3-px^2+qx-r=0$ has all of its three roots equal, is given by
- (a) $p^2=3qr$ ☐
- (b) $q^2=3pr$ ☐
- (c) $r^2=3pq$ ☐
- (d) None of the above. ☐
40. The condition that the roots of the equation $x^3-px^2+qx-r=0$ may be in G.P., is given by
- (a) $p^3r=q^3$ ☐
- (b) $q^3p=r^3$ ☐

- (c) $r^3q = p^3$ ☐
 (d) None of the above. ☐

41. The condition that the roots of the equation $x^3 - px^2 + qx - r = 0$ be in H.P., is given by

- (a) $2r^2 - 9pqr + 27q^3 = 0$ ☐
 (b) $27r^2 + 9pqr + 2q^3 = 0$ ☐
 (c) $27r^2 - 9pqr + 2q^3 = 0$ ☐
 (d) $2r^2 + 9pqr + 27q^3 = 0$ ☐

In the following problems, let α, β, γ be the roots of the cubic $x^3 + px^2 + qx + r = 0$, then

42. $\Sigma\alpha^2\beta$ is equal to

- (a) $\Sigma\alpha \cdot \Sigma\alpha\beta + 3\alpha\beta\gamma$ ☐
 (b) $\Sigma\alpha \cdot \Sigma\alpha\beta + \alpha\beta\gamma$ ☐
 (c) $\Sigma\alpha \cdot \Sigma\alpha\beta - 3\alpha\beta\gamma$ ☐
 (d) $\Sigma\alpha \cdot \Sigma\alpha\beta - \alpha\beta\gamma$ ☐

43. $\Sigma\alpha^3$ is equal to

- (a) $\Sigma\alpha \Sigma\alpha^2 - \Sigma\alpha^2\beta$ ☐
 (b) $\Sigma\alpha \Sigma\alpha^2 + \Sigma\alpha^2\beta$ ☐
 (c) $\Sigma\alpha \Sigma\alpha^2 - \Sigma\alpha^2\beta$ ☐
 (d) $\Sigma\alpha \Sigma\alpha^2 + 3\Sigma\alpha^2\beta$ ☐

44. $\Sigma\alpha^2\beta^2$ is equal to

- (a) $(\Sigma\alpha\beta)^2 - 2\Sigma\alpha^2\beta\gamma$ ☐
 (b) $(\Sigma\beta\gamma)^2 - 2\Sigma\beta^2\gamma\alpha$ ☐
 (c) $(\Sigma\gamma\alpha)^2 - 2\Sigma\gamma^2\alpha\beta$ ☐
 (d) All of the above. ☐

45. $\Sigma\alpha^3\beta$ is equal to

- (a) $\Sigma\alpha^2\Sigma\alpha\beta + \alpha\beta\gamma\Sigma\alpha$ ☐
 (b) $\Sigma\alpha^2\Sigma\alpha\beta - \alpha\beta\gamma\Sigma\alpha$ ☐
 (c) $\Sigma\alpha^3\Sigma\beta - \Sigma\alpha^2\beta^2$ ☐
 (d) None of the above. ☐

46. $\Sigma\alpha^3\beta^2$ is equal to

- (a) $\Sigma\alpha \Sigma\alpha^2\beta^2 - \alpha\beta\gamma\Sigma\alpha\beta$ ☐
 (b) $\alpha\beta\gamma \Sigma\alpha\beta - \Sigma\alpha \Sigma\alpha^2\beta^2$ ☐
 (c) $\alpha\beta\gamma \Sigma\alpha\beta + \Sigma\alpha \Sigma\alpha^2\beta^2$ ☐
 (d) None of the above. ☐

Let $\alpha, \beta, \gamma, \delta$ be the roots of the equation $x^4 + px^3 + qx^2 + rx + s = 0$, then

47. $\Sigma\alpha^2\beta$ is equal to

- (a) $\Sigma\alpha \Sigma\alpha\beta - 3\alpha\beta\gamma$ ☐
 (b) $\Sigma\alpha^2 \Sigma\alpha\beta - 3\Sigma\alpha\beta\gamma$ ☐
 (c) $\Sigma\alpha^2 \Sigma\alpha\beta - 3\alpha\beta\gamma$ ☐
 (d) $\Sigma\alpha \Sigma\alpha\beta - 3 \Sigma\alpha\beta\gamma$ ☐

48. $\Sigma\alpha^2\beta\gamma$ is equal to

- (a) $\alpha\beta\gamma \Sigma\alpha$ ☐
 (b) $\Sigma\alpha \Sigma\alpha\beta\gamma$ ☐
 (c) $\Sigma\alpha \Sigma\alpha\beta\gamma - 4\alpha\beta\gamma\delta$ ☐
 (d) None of the above. ☐

49. $\Sigma\alpha^2\beta^2$ is equal to

- (a) $(\Sigma\alpha\beta)^2 - 2\Sigma\alpha^2\beta\gamma - 3\alpha\beta\gamma\delta$ ☐
 (b) $(\Sigma\alpha\beta)^2 - 2\Sigma\alpha^2\beta\gamma - 6\alpha\beta\gamma\delta$ ☐
 (c) $(\Sigma\alpha\beta)^2 - 6\Sigma\alpha^2\beta\gamma - 2\alpha\beta\gamma\delta$ ☐
 (d) None of the above. ☐

50. $\Sigma\alpha^3\beta$ is equal to

- (a) $\Sigma\alpha^2 \Sigma\alpha\beta + \Sigma\alpha^2\beta\gamma$ ☐
 (b) $\Sigma\alpha^2 \Sigma\alpha\beta - \Sigma\alpha^2\beta\gamma$ ☐
 (c) $\Sigma\alpha^2\Sigma\alpha\beta + \alpha\beta\gamma$ ☐
 (d) $\Sigma\alpha^2\Sigma\alpha\beta - \alpha\beta\gamma$ ☐

51. $\sum \frac{\alpha}{\beta}$ is equal to

- (a) $\Sigma\alpha \cdot \sum \frac{1}{\alpha} + 4$ ☐
 (b) $\Sigma\alpha \cdot \sum \frac{1}{\alpha}$ ☐
 (c) $\Sigma\alpha \cdot \sum \frac{1}{\alpha} - 4$ ☐
 (d) None of the above ☐

Note: $\frac{1}{\alpha}, \frac{1}{\beta}, \frac{1}{\gamma}, \frac{1}{\delta}$ are the roots of the equation

$$sx^4 + rx^3 + qx^2 + px + 1 = 0$$

52. $\sum \frac{\alpha\beta}{\gamma^2}$ is equal to

- (a) $\Sigma\alpha\beta \sum \frac{1}{\alpha^2} - \sum \frac{\alpha}{\beta}$ ☐
 (b) $\Sigma\alpha\beta \left(\sum \frac{1}{\alpha} \right)^2 + \sum \frac{\alpha}{\beta}$ ☐
 (c) $\Sigma\alpha\beta \sum \frac{1}{\alpha} - \sum \frac{\alpha}{\beta}$ ☐
 (d) None of the above. ☐

Note: $\sum \frac{1}{\alpha^2} = \left(\sum \frac{1}{\alpha} \right)^2 - 2 \sum \frac{1}{\alpha\beta}$
 where
 $\sum \frac{1}{\alpha} = -\frac{r}{s}$

$$\sum \frac{1}{\alpha\beta} = \frac{q}{s}$$

53. The equation $x^5 + x^3 + 2x + 1 = 0$ has how many positive roots ?

- (a) None ☐
 (b) Two ☐
 (c) Four ☐
 (d) None of the above. ☐

54. The equation $x^9 + 2x^5 + 3x^3 + x = 0$ has how many real roots ?

- (a) One ☐
 (b) Two ☐
 (c) Four ☐
 (d) Eight ☐

55. The least possible number of positive roots of the equation $2x^7 - x^4 + 4x^3 - 5 = 0$ is

- (a) Two ☐
 (b) Four ☐
 (c) Six ☐
 (d) None of the above. ☐

56. If $f(a)$ and $f(b)$ have contrary signs, then the equation $f(x) = 0$ has

- (a) Only one root between a and b ☐
 (b) All the roots between a and b ☐
 (c) Atleast one root between a and b ☐
 (d) None of the above. ☐

57. If $f(a)$ and $f(b)$ are of opposite signs, then the number of roots of $f(x) = 0$ lying between a and b is

- (a) Odd ☐
 (b) Even ☐
 (c) Either even or odd ☐
 (d) None of the above ☐

58. Mark the correct statement :

If $f(a)$ and $f(b)$ are of the same sign, then $f(x) = 0$ may have

- (a) No root between a and b ☐
 (b) An even number of roots between a and b ☐
 (c) Both of the above ☐
 (d) None of the above ☐

59. The condition that the equation

$$z^3 + 3Hz + G = 0$$

may have two equal roots is that

- (a) $9H^2 - 4G = 0$
 (b) $G^2 + 4H^3 = 0$
 (c) $H = 0$ but $G \neq 0$
 (d) $G = 0$ but $H \neq 0$

Note :—Readers may please note that the given cubic equation

$$a_0x^3 + 3a_1x^2 + 3a_2x + a_3 = 0$$

can be transformed to

$$z^3 + 3Hz + G = 0$$

where

$$z = a_0x + a_1$$

$$H = a_0a_2 - a_1^2$$

$$G = a_0^2a_3 - 3a_0a_1a_2 + 2a_1^3$$

60. All the roots of the cubic

$$z^3 + 3Hz + G = 0$$

will be real if

- (a) $G^2 + 4H^3 < 0$
 (b) $G^2 + 4H^3 > 0$
 (c) $G^2 + 4H^3 = 0$
 (d) None of the above

61. All the roots of the cubic

$$z^3 + 3Hz + G = 0$$

will be equal if

- (a) $G^2 + 4H^3 > 0$
 (b) $G^2 + 4H^3 = 0$
 (c) $G = 0$ and $H = 0$
 (d) None of the above

62. Two of the roots of the cubic

$$z^3 + 3Hz + G = 0$$

will be equal if

- (a) $G^2 + 4H^3 > 0$
 (b) $G^2 + 4H^3 = 0$
 (c) $G = 0$ and $H = 0$
 (d) Either $G = 0$ or $H = 0$

63. Two of the roots of the cubic

$$z^3 + 3Hz + G = 0$$

will be imaginary if

- (a) $G^2 + 4H^3 > 0$
 (b) $G^2 + 4H^3 < 0$
 (c) $G^2 + 4H^3 = 0$
 (d) $G = 0$ and $H = 0$

64. Cardon's method will fail to give the solution of the cubic $z^3 + 3Hz + G = 0$ when

(a) $G^2 + 4H^3 > 0$ ☐

(b) $G^2 + 4H^3 = 0$ ☐

(c) $G^2 + 4H^3 < 0$ ☐

(d) $G=0$ and $H=0$ ☐

65. In order to solve a cubic equation
 $a_0x^3 + 3a_1x^2 + 3a_2x + a_3 = 0$

by Cardon's method, it is necessary to remove the

(a) Constant term ☐

(b) Third term ☐

(c) Second term ☐

(d) Second term as well as the constant term ☐

66. One root of a reciprocal equation of the second kind and odd degree is always

(a) i ☐

(b) $-i$ ☐

(c) 1 ☐

(d) -1 ☐

67. Two roots of a reciprocal equation of the second kind and even degree are always

(a) 1 and i ☐

(b) -1 and i ☐

(c) 1 and $-i$ ☐

(d) 1 and -1 ☐

68. If S_k denotes the sum of the k th powers of the roots of the equation

$$x^5 + px^4 + qx^2 + t = 0$$

then the value of S_{-4} is given by

(a) $-\frac{2q}{t}$ ☐

(b) 0 ☐

(c) $\frac{2q^2}{t^2} - \frac{4p}{t}$ ☐

(d) $p^2 + 6p^3q + 3q^2 + 6pt$ ☐

69. If the product of two roots of the equation $x^4 - px^3 + qx^2 - rx + s = 0$, is equal to the product of the other two roots then

(a) $s = p + q + r$ ☐

(b) $p^2 = r^2s$ ☐

(c) $p^3 - 4pq + 8r = 0$ ☐

(d) $r^2 = p^2s$ ☐

70. A reciprocal equation $f(x)=0$ is one which-----when x changes to $\frac{1}{x}$.

(a) Remains unaltered ☐

(b) Has complex conjugate pairs as its roots ☐

(c) Has equal roots ☐

(d) None of the above ☐

71. If $\alpha, \beta, \gamma, \delta$ are the roots of

$$aX^4 + bX^3 + cX + d = 0$$

then the equation, whose roots are

$$2\alpha, 2\beta, 2\gamma, 2\delta$$

is given by

(a) $2aX^4 + 2bX^3 + 2cX + d = 0$ ☐

(b) $aX^4 + 2bX^3 + 4cX + 8d = 0$ ☐

(c) $aX^4 + 2bX^3 + 8cX + 16d = 0$ ☐

(d) $aX^4 + 2bX^3 + 2cX + 2d = 0$ ☐

72. Every equation of even degree whose last term is negative and the coefficient of the first term positive, has—

(a) All of its roots imaginary ☐

(b) All of its roots real ☐

(c) At least two real roots ☐

(d) None of the above ☐

73. Every equation of an odd degree has—whose sign is opposite to that of its last term, the coefficient of the first term being positive.

(a) At least one imaginary root ☐

(b) At least one positive root ☐

(c) At least one negative root ☐

(d) At least one real root ☐

74. If $f(a)$ and $f(b)$ are of opposite signs, then between a and b $f(x)=0$ has

(a) All its real roots ☐

(b) Only one real root ☐

(c) An even number of real roots or no real root ☐

(d) Atleast one real root ☐

75. On removing fractional coefficients the equation

$$X^4 + \frac{3}{10}X^2 + \frac{13}{25}X + \frac{77}{1000} = 0 \text{ becomes}$$

(a) $1000X^4 + 300X^2 + 520X + 770 = 0$ ☐

(b) $X^4 + 3X^2 + 52X^2 + 77 = 0$ ☐

(c) $X^4 + 30X^2 + 520X + 770 = 0$ ☐

(d) $X^4 + 10X^2 + 25X + 1000 = 0$ ☐

76. The zero of the polynomial $3x^3 + 4x^2 - 7$ is

(a) 0 ☐

(b) 1 ☐

(c) -1 ☐

(d) 2 ☐

77. If α is a zero of the polynomial $f(x)$ then $f(x)$ is divisible by

(a) α ☐

(b) $x - \alpha$ ☐

(c) $x + \alpha$ ☐

(d) 0 ☐

78. If $5x^5 + 4x^4 - 3x^3 + 8x^2 + 2$ is divided by $x + 1$, then the quotient is given by

(a) $5x^4 - x^3 - 2x^2 - 10$ ☐

(b) $5x^4 - x^3 - 2x^2 + 10x - 10$ ☐

(c) $5x^4 + x^3 - 2x^2 + 10x + 10$ ☐

(d) None of the above ☐

79. When the polynomial $f(x)$ is divided by $(x - \alpha)(x - \beta)$ ($\alpha \neq \beta$), then the remainder is given by

(a) $f(\alpha) \cdot f(\beta)$ ☐

(b) $f(\alpha) + f(\beta)$ ☐

(c) $\frac{(x - \beta)f(\alpha) - (x - \alpha)f(\beta)}{\alpha - \beta}$ ☐

(d) $\frac{(x - \alpha)f(\alpha) - (x - \beta)f(\beta)}{\alpha - \beta}$ ☐

80. If α and β are the roots of the equation $3x^3 - 10x^2 + x + 6 = 0$ and are connected by the relation $\alpha\beta - \alpha - 2 = 0$, then the third root of the equation will be

(a) $2/3$ ☐

(b) $-2/3$ ☐

(c) $3/2$ ☐

(d) $-3/2$ ☐

81. The equation which shall have

$\omega\sqrt[3]{Q + \sqrt{Q^2 + P^3}} + \omega^2\sqrt[3]{Q - \sqrt{Q^2 + P^3}}$ for a root (where $\omega^3 = 1$), is given by

(a) $x^3 - 3Px + 2Q = 0$ ☐

(b) $x^3 + 2Px - 3Q = 0$ ☐

(c) $x^3 + 3Px - 2Q = 0$ ☐

(d) $x^3 - 2Px + 3Q = 0$ ☐

82. The equation

$$\frac{A^2}{x-a} + \frac{B^2}{x-b} + \frac{C^2}{x-c} + \dots + \frac{K^2}{x-k} = x + l,$$

where A, B, C etc. ; a, b, c , etc. ; and l are real numbers, has

(a) All of its roots imaginary ☐

(b) All of its roots real ☐

(c) Two of the roots imaginary and the remaining real ☐

(d) Two of the roots real and the remaining imaginary ☐

83. If $\alpha_1, \alpha_2, \dots, \alpha_n$ are the roots of the equation $(\beta_1 - x)(\beta_2 - x) \dots (\beta_n - x) + A = 0$, then the equation whose roots are $\beta_1, \beta_2, \dots, \beta_n$ is given by

(a) $(\beta_1 - x)(\beta_2 - x) \dots (\beta_n - x) = 0$ ☐

(b) $(\beta_1 - x)(\beta_2 - x) \dots (\beta_n - x) + A = 0$ ☐

(c) $(\alpha_1 - x)(\alpha_2 - x) \dots (\alpha_n - x) - A = 0$ ☐

(d) $(\alpha_1 - x)(\alpha_2 - x) \dots (\alpha_n - x) + A = 0$ ☐

84. If $\alpha_1, \alpha_2, \dots, \alpha_n$ are the roots of the equation $x^n + na_1x^{n-1} - b = 0$, then $(\alpha_1 - \alpha_2)(\alpha_1 - \alpha_3) \dots (\alpha_1 - \alpha_n)$ is equal to

(a) $n(\alpha_1^{n-1} + a)$ ☐

(b) $\alpha_1^{n-1} + a$ ☐

(c) $n\alpha_1^{n-1} + a$ ☐

(d) $\alpha_1^{n-1} + na$ ☐

85. The quadratic equation, whose roots are the two common roots of the equations $x^3 + px^2 + qx + r = 0$ and $x^3 + p'x^2 + q'x + r' = 0$, is given by

(a) $x^2 + \frac{p-p'}{q-q'}x + \frac{p-p'}{r-r'} = 0$ ☐

(b) $x^2 + \frac{q-q'}{p-p'}x + \frac{p-p'}{r-r'} = 0$ ☐

(c) $x^2 + \frac{p-p'}{q-q'}x + \frac{r-r'}{p-p'} = 0$ ☐

(d) $x^2 + \frac{q-q'}{p-p'}x + \frac{r-r'}{p-p'} = 0$ ☐

86. The condition that two of the roots α and β of the equation $x^3 - px^2 + qx - r = 0$ are connected by the relation $\alpha + \beta = 0$, is given by

(a) $pq = r$ ☐

(b) $qr = p$ ☐

(c) $rp = q$ ☐

(d) None of the above ☐

87. If $x + ar, y + ar^2z + ar^3t = ar^4$ ($r = 1, 2, 3, 4$) then z is equal to

(a) $a_1 + a_2 + a_3 + a_4$ ☐

(b) $-a_1a_2 - a_1a_3 - a_1a_4 - a_2a_3 - a_2a_4 - a_3a_4$ ☐

(c) $a_1a_2a_3 + a_1a_2a_4 + a_1a_3a_4 + a_2a_3a_4$ ☐

(d) $a_1a_2a_3a_4$ ☐

88. If we square either of the imaginary cube roots of unity, we obtain

(a) A 6th root of unity ☐

(b) Its real root ☐

(c) The other imaginary root ☐

(d) None of the above ☐

89. If a, b, c are the roots of the equation $x^3 + px^2 + qx + r = 0$, then Σa^3 is equal to

(a) $p^3 - 2q$ ☐

(b) $q^2 - 2pr$ ☐

(c) $-p^3 + 3pq - 3r$ ☐

(d) $p^3 + 2pr^2 - 3pr$ ☐

90. If the roots of the equation

$$x^3 - 12x^2 + 39x - 28 = 0$$

are in A.P., then the difference between two of its roots is

(a) 1 ☐

(b) 3 ☐

(c) $\sqrt{2}$ ☐

(d) $\sqrt{4}$ ☐

91. If the roots of the equation

$$x^3 - 12x^2 + 39x - 28 = 0$$

are in A.P., then one of its roots is

(a) -3 ☐

(b) 3 ☐

(c) 4 ☐

(d) 6 ☐

92. If $\alpha_1, \alpha_2, \alpha_3, \dots, \alpha_n$ are the roots of the equation

$$x^n + p_1x^{n-1} + p_2x^{n-2} + \dots + p_{n-1}x + p_n = 0,$$

then the value of $\Sigma \alpha^3$ for the given equation is given by

(a) $p_1^2 - 2p_2$ ☐

(b) $3p_1p_2 - p_1^3 - 3p_3$ ☐

(c) p_3 ☐

(d) None of the above. ☐

93. If two of the roots of the equation $x^3 - 5x^2 - 16x + 80 = 0$ are equal in magnitude but opposite in sign, then the third root will be

(a) 5 ☐

(b) 16 ☐

(c) -80 ☐

(d) None of the above. ☐

94. The given equation $x^3 - px^2 + qx - r = 0$ has two of its roots equal if

(a) $4(9r - pq)^2 = (q^2 - 3pr)(p^2 - 3q)$ ☐

(b) $(9r - pq)^2 = 4(q^2 - 3pr)(p^2 - 3q)$ ☐

(c) $4(pq - 9r)^2 = (3pr - q^2)(p^2 - 3q)$ ☐

(d) $(pq - 9r)^2 = 4(3pr - q^2)(p^2 - 3q)$ ☐

95. The condition that the roots of the equation $x^3 - px^2 + qx - r = 0$ may be in A.P., is given by

(a) $4p^3 - 9pq + 27r = 0$ ☐

(b) $-2p^3 - 9pq + 27r = 0$ ☐

(c) $2p^3 + 9pq + 27r = 0$ ☐

(d) $2p^3 - 9pq + 27r = 0$ ☐

96. The condition that the biquadratic $x^4 + px^3 + qx^2 + rx + s = 0$ may have two pairs of equal roots, is given by

(a) $r^2 = p^2s$ ☐

(b) $s^2 = q^2p$ ☐

(c) $p^2 = r^2q$ ☐

(d) $q^2 = s^2r$ ☐

97. If $\alpha_1, \alpha_2, \dots, \alpha_n$ are the roots of the equation $x^n - p_1x^{n-1} + p_2x^{n-2} - p_3x^{n-3} + \dots + (-1)^np_n = 0$

then the value of $(1 + \alpha_1)(1 + \alpha_2)\dots(1 + \alpha_n)$ is given by

(a) $1 + p_n$ ☐

(b) $1 + p_1 + p_2 + \dots + p_n$ ☐

(c) $p_1 + p_2 + \dots + p_n$ ☐

(d) $1 - p_1 - p_2 - \dots - p_n$ ☐

98. The equation

$$x^7 + x^5 - 2x^4 + x^3 - 3x^2 + 7x - 5 = 0$$

has how many negative roots?

(a) None ☐

(b) Two ☐

(c) Four ☐

(d) Six ☐

99. The equation $2x^8 + 3x^4 + x^2 + 7 = 0$ has how many real roots?

- (a) None ☐
 (b) Two ☐
 (c) Four ☐
 (d) Eight ☐

100. The least possible number of imaginary roots of the equation $x^9 - x^5 + x^4 + x^2 + 1 = 0$ is

- (a) Two ☐
 (b) Four ☐
 (c) Six ☐
 (d) Eight ☐

101. A lower limit to the number of imaginary roots of the equation $x^6 - 3x^2 - x + 1 = 0$ is

- (a) 0 ☐
 (b) 2 ☐
 (c) 4 ☐
 (d) 6 ☐

102. The equation $2x^4 + 5x^2 + 3 = 0$ has ——— real root/roots.

- (a) No ☐
 (b) One ☐
 (c) Two ☐
 (d) Four ☐

103. If α, β, γ are the roots of $y^3 + 3Hy + G = 0$,

then the equation whose roots are $(\alpha - \beta)^2, (\beta - \gamma)^2$ and $(\gamma - \alpha)^2$ is given by

- (a) $y^3 + 18H^2y^2 + 81Hy + 27G^2 = 0$ ☐
 (b) $y^3 + 18Hy^2 + 81H^2y + 108H^3 = 0$ ☐
 (c) $y^3 + 18Hy^2 + 81H^2y + 27(G^2 + 4H^3) = 0$ ☐
 (d) None of the above. ☐

104. Let $\alpha_1, \alpha_2, \dots, \alpha_n$ be the roots of the equation $f(x) = 0$, then to find the equation

with roots as $\alpha_1 - c, \alpha_2 - c, \dots, \alpha_n - c$; which of the following substitution is to be made?

- (a) $y = x + c$ ☐
 (b) $y = x - c$ ☐
 (c) $y = cx$ ☐
 (d) $y = -cx$ ☐

105. Given that two roots of the equation $X^4 - 6X^3 + 18X^2 - 30X + 25 = 0$ are of the form $\alpha + i\beta$ and $\beta + i\alpha$, then

- (a) It is not possible to solve the equation ☐
 (b) The equation possesses real roots ☐
 (c) The equation possesses integral roots ☐
 (d) None of the above. ☐

106. The equation, whose one root is

$$\sqrt{2} + \sqrt{-3}, \text{ is given by}$$

- (a) $X^4 + 2X^3 + 3X^2 + 6 = 0$ ☐
 (b) $X^4 + 2X^2 + 25 = 0$ ☐
 (c) $2X^4 + 3X^2 - 2X + 3 = 0$ ☐
 (d) None of the above. ☐

107. Which one of the following substitutions transforms the equation

$$X^3 - px^2 + qx - r = 0,$$

whose roots are α, β, γ ; into one whose roots are $\beta\gamma + \frac{1}{\alpha}, \alpha\gamma + \frac{1}{\beta}, \alpha\beta + \frac{1}{\gamma}$.

- (a) $y = \frac{p+q+r}{x}$ ☐
 (b) $y = \frac{r+1}{x}$ ☐
 (c) $y = px + \frac{q}{x}$ ☐
 (d) $y = x + \frac{1}{x}$ ☐

ANSWERS

- | | | | | | |
|-------|-------|-------|-------|-------|-------|
| 1. a | 2. c | 3. c | 19. c | 20. a | 21. c |
| 4. c | 5. b | 6. d | 22. c | 23. c | 24. d |
| 7. a | 8. a | 9. c | 25. d | 26. c | 27. c |
| 10. c | 11. a | 12. d | 28. d | 29. a | 30. c |
| 13. c | 14. b | 15. a | 31. c | 32. c | 33. b |
| 16. c | 17. c | 18. d | 34. a | 35. c | 36. a |

37. <i>b</i>	38. <i>a</i>	39. <i>b</i>	73. <i>d</i>	74. <i>d</i>	75. <i>b</i>
40. <i>a</i>	41. <i>c</i>	42. <i>c</i>	76. <i>b</i>	77. <i>b</i>	78. <i>b</i>
43. <i>a</i>	44. <i>d</i>	45. <i>b</i>	79. <i>c</i>	80. <i>b</i>	81. <i>c</i>
46. <i>a</i>	47. <i>d</i>	48. <i>c</i>	82. <i>b</i>	83. <i>c</i>	84. <i>a</i>
49. <i>b</i>	50. <i>b</i>	51. <i>c</i>	85. <i>d</i>	86. <i>a</i>	87. <i>b</i>
52. <i>a</i>	53. <i>a</i>	54. <i>a</i>	88. <i>c</i>	89. <i>c</i>	90. <i>b</i>
55. <i>d</i>	56. <i>c</i>	57. <i>a</i>	91. <i>c</i>	92. <i>b</i>	93. <i>a</i>
58. <i>c</i>	59. <i>b</i>	60. <i>a</i>	94. <i>b</i>	95. <i>d</i>	96. <i>a</i>
61. <i>c</i>	62. <i>b</i>	63. <i>a</i>	97. <i>b</i>	98. <i>a</i>	99. <i>a</i>
64. <i>c</i>	65. <i>c</i>	66. <i>c</i>	100. <i>c</i>	101. <i>b</i>	102. <i>a</i>
67. <i>d</i>	68. <i>c</i>	69. <i>d</i>	103. <i>c</i>	104. <i>b</i>	105. <i>d</i>
70. <i>a</i>	71. <i>c</i>	72. <i>c</i>	106. <i>b</i>	107. <i>b</i>	

Matrices

1. A matrix is

- (a) A real number ☐
 (b) Either a real or a complex number. ☐
 (c) An arrangement of mn numbers, over the given set S , in a rectangular array of m rows and n columns. ☐
 (d) Same as determinant ☐

2. $\begin{bmatrix} 1 & i & -1 \\ 2 & -1 & i \\ 4 & 5 & 3+i \end{bmatrix}$ is a 3×3 matrix

over the set of

- (a) Natural numbers ☐
 (b) Integers ☐
 (c) Real numbers ☐
 (d) Complex numbers ☐

3. $1 \times n$ matrices are called

- (a) Row vectors ☐
 (b) Column vectors ☐
 (c) Null matrices ☐
 (d) Scalar matrices ☐

4. $\begin{bmatrix} b & 0 & 0 \\ 0 & b & 0 \\ 0 & 0 & b \end{bmatrix}$ is called a

- (a) Diagonal matrix ☐
 (b) Scalar matrix ☐
 (c) Unit matrix ☐
 (d) Skew symmetric matrix ☐

5. A submatrix of the given matrix can be obtained by deleting

- (a) The first row and the first column of the given matrix ☐
 (b) Any number of rows and one column of the given matrix ☐
 (c) One row and any number of columns of the given matrix ☐
 (d) Any numbers of rows and any number of columns of the given matrix ☐

6. Two matrix A and B are said to be comparable iff

- (a) Number of rows in A is equal to the number of columns in B ☐
 (b) Number of columns in A is equal to the number of row in B ☐
 (c) Number of rows and columns in A is equal to the numbers of rows and columns in B ☐
 (d) None of the above ☐

7. If $A = \begin{bmatrix} 1 & 5 & 7 \\ -2 & 0 & 4 \end{bmatrix}$ and

$B = \begin{bmatrix} 4 & 8 & 3 \\ 6 & 9 & 1 \end{bmatrix}$, then $A \times B =$

- (a) $\begin{bmatrix} 5 & 11 & 10 \\ 8 & 9 & 5 \end{bmatrix}$ ☐
 (b) $\begin{bmatrix} 5 & 13 & 10 \\ 4 & 9 & 5 \end{bmatrix}$ ☐

$$(c) \begin{bmatrix} 5 & 13 & 10 \\ 4 & 9 & 4 \end{bmatrix}$$

$$(d) \begin{bmatrix} 9 & 9 & 7 \\ 6 & 7 & 5 \end{bmatrix}$$

8. The matrix addition is

(a) Associative but not commutative ☐

(b) Commutative but not associative ☐

(c) Associative and commutative both ☐

(d) None of above ☐

9. If $4X = \begin{bmatrix} 1 & 2 & 1 \\ 4 & 2 & 3 \\ -1 & 9 & 7 \end{bmatrix}$, then $X =$

$$(a) \begin{bmatrix} 1/4 & 2 & 1 \\ 1 & 2 & 3 \\ -1/4 & 9 & 7 \end{bmatrix}$$

$$(b) \begin{bmatrix} 1/4 & \frac{1}{2} & 1/4 \\ 4 & 2 & 3 \\ -1 & 9 & 7 \end{bmatrix}$$

$$(c) \begin{bmatrix} 1/4 & 2 & 1 \\ 4 & \frac{1}{2} & 3 \\ -1 & 9 & 7/4 \end{bmatrix}$$

$$(d) \begin{bmatrix} 1/4 & \frac{1}{2} & 1/4 \\ 1 & \frac{1}{2} & 3/4 \\ -1/4 & 9/4 & 7/4 \end{bmatrix}$$

10. If $A = \begin{bmatrix} 2 & 1 & 4 \\ 3 & 0 & 5 \end{bmatrix}$ and

$$B = \begin{bmatrix} 3 & 4 \\ 1 & 0 \\ 2 & -1 \end{bmatrix}$$

then AB is a matrix of order

(a) 2×3 ☐

(b) 3×2 ☐

(c) $\infty \times 2$ ☐

(d) 3×3 ☐

11. If A and B are same as in Q. 10, then AB is equal to

$$(a) \begin{bmatrix} 15 & 19 \\ 4 & 7 \end{bmatrix}$$

$$(b) \begin{bmatrix} 12 & 10 \\ 14 & 11 \end{bmatrix}$$

$$(c) \begin{bmatrix} 15 & 4 \\ 19 & 7 \end{bmatrix}$$

(d) None of the above ☐

12. If D_1, D_2 are two diagonal matrices then

(a) $D_1 D_2$ is a diagonal matrix ☐

(b) $D_1 D_2 = D_2 D_1$ ☐

(c) Both of the above ☐

(d) None of the above ☐

13. Matrix multiplication is

(a) Associative but not commutative ☐

(b) Commutative but not associative ☐

(c) Associative as well as commutative ☐

(d) None of the above ☐

14. Which of the following statements is wrong

The trace of a matrix $A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}$

is defined by $T_r(A) = a_{11} + a_{22}$

(a) Trace of a unit matrix is always a fixed natural number ☐

(b) Trace of the sum of two matrices is equal to sum of their traces ☐

(c) Trace of the scalar matrix is some multiple of its order ☐

(d) $T_r(AB) = T_r(BA)$ ☐

15. If order of the matrix A is $n \times m$ then order of A^T , the transpose of A is given by

- (a) $n \times m$ ☐
 (b) $n \times n$ ☐
 (c) $m \times n$ ☐
 (d) $m \times m$ ☐

16. Which of the following statements is correct?

- (a) $(A+B)^T = A^T + B^T$ ☐
 (b) $(AB)^T = A^T B^T$ ☐
 (c) $(KA)^T = K^T A^T$ ☐
 (d) None of the above ☐

17. Which one of the following is not an elementary operation?

- (a) The interchange of two rows or columns ☐
 (b) The multiplication of a row or a column by any real number ☐
 (c) The addition of a multiple of one row or column to another row or column ☐
 (d) The multiplication of a row or a column by any nonzero number ☐

18. Which one of the following statements is incorrect for a triangular matrix $A = (a_{ij})$?

- (a) A must be an square matrix ☐
 (b) $a_{ij} = 0$ for all $i > j$ ☐
 (c) It is not necessary that the elements $a_{ij} \neq 0$ for all $i \leq j$ ☐
 (d) The elements in the principal diagonal may or may not be zero. ☐

19. Mark the correct definition of rank of a matrix

- (a) A number p is said to be the rank of the matrix A if every minor of order $(r+1)$ vanishes ☐
 (b) A number p is said to be the rank of the matrix A if there exists at least one minor of order r which does not vanish ☐

- (c) A number p is said to be the rank of the matrix A if there exists at least one minor of order r which does not vanish and every minor of order $(r+1)$ vanishes ☐
 (d) A number p is said to be the rank of the matrix A if the determinant of any $p \times p$ sub-matrix of A is nonzero. ☐

20. The rank of matrix

$$\begin{bmatrix} 1 & 1 & 1 \\ a & b & c \\ a^2 & b^2 & c^2 \end{bmatrix}$$

a, b, c being all real, is 3 if

- (a) $a=b=c$ ☐
 (b) a, b, c are all different but $a+b+c=0$ ☐
 (c) Two of the numbers a, b, c are equal but are different from the third ☐
 (d) a, b, c are all different but $a+b+c \neq 0$. ☐

21. Two matrices A and B are said to be anti-commute if

- (a) $AB=BA$ ☐
 (b) $AB^2=A^2B$ ☐
 (c) $AB=-BA$ ☐
 (d) $A/B=B/A$ ☐

22. A matrix A such that $A^2=A$, is called

- (a) Idempotent ☐
 (b) Nilpotent ☐
 (c) Involutory ☐
 (d) Triangular. ☐

23. A matrix A such that $A^2=I$, is called

- (a) Idempotent ☐
 (b) Involutory ☐
 (c) Nilpotent of order 2 ☐
 (d) Triangular ☐

24. A matrix A such that $A^m = 0$ for some positive integer and $A^k \neq 0$ for any $k < m$, is said to be

- (a) Involutory ☐
 (b) Nilpotent of order m ☐
 (c) Nilpotent of order k ☐
 (d) None of the above ☐

25. A square matrix A such that $A^T = A$, is called a

- (a) Symmetric matrix ☐
 (b) Skew symmetric matrix ☐
 (c) Hermitian matrix ☐
 (d) Skew Hermitian matrix ☐

26. A square matrix A such that $A^T = -A$, is called a

- (a) Symmetric matrix ☐
 (b) Hermitian matrix ☐
 (c) Skew Hermitian matrix ☐
 (d) Skew Symmetric matrix ☐

27. Mark the incorrect statement. If A^* and B^* are the transpose of the conjugates of A and B respectively, then

- (a) $(A^*)^* = A$ ☐
 (b) $(AB)^* = A^*B^*$, A and B being conformable to multiplication ☐
 (c) $(A+B)^* = A^* + B^*$, A and B being comparable ☐
 (d) $kA^* = \bar{k}A^*$, k being any complex number and $\bar{k}$ denotes the conjugate of k ☐

28. A square matrix A is said to be Hermitian if

- (a) $\bar{A} = A$ ☐
 (b) $\bar{A} = -A$ ☐
 (c) $A^* = A$ ☐
 (d) $A^* = -A$ ☐

29. A square matrix A is said to be skew Hermitian if

- (a) $\bar{A} = A$ ☐
 (b) $A^* = A$ ☐

- (c) $\bar{A} = -A$ ☐
 (d) $A^* = -A$ ☐

30. Mark the incorrect statement :

- (a) The diagonal elements of a skew symmetric matrix are all nonzero ☐
 (b) Every square matrix can be uniquely expressed as the sum of a symmetric and a skew symmetric matrix ☐
 (c) If A is any square matrix, then $A + A'$ is symmetric and $A - A'$ is skew symmetric ☐
 (d) If A is any matrix, then AA' and $A'A$ are both symmetric. ☐

31. The diagonal elements of a skew Hermitian matrix are

- (a) All nonzero reals ☐
 (b) All pure imaginaries or zero ☐
 (c) Some nonzero reals and some imaginary ☐
 (d) None of the above ☐

32. To convert a Hermitian matrix into skew-Hermitian one, the Hermitian matrix must be multiplied by

- (a) -1 ☐
 (b) i ☐
 (c) $-i$ ☐
 (d) None of the above ☐

33. Which is not correct? If A is any square matrix, then ——— is Hermitian.

- (a) $A + A^*$ ☐
 (b) AA^* ☐
 (c) $A - A^*$ ☐
 (d) A^*A ☐

34. Every square matrix is uniquely expressible as

- (a) The sum of a Hermitian and a skew Hermitian matrix ☐
 (b) $A = iB$, where A and B both are symmetric ☐

(c) $A+iB$, where A and B are real skew-symmetric matrices ☐

(d) The sum of a symmetric and a Hermitian matrix ☐

35. If A is any square matrix, then $A-A^*$ is a ☐

(a) Symmetric matrix ☐

(b) Skew-symmetric matrix ☐

(c) Hermitian matrix ☐

(d) Skew-Hermitian matrix ☐

36. A square matrix A is said to be ☐ if $AA^T=I$.

(a) Idempotent ☐

(b) Orthogonal ☐

(c) Unitary ☐

(d) None of the above. ☐

37. A square matrix A is said to be ☐ if $A^*A=I$.

(a) Orthogonal ☐

(b) Unitary ☐

(c) Symmetric ☐

(d) Hermitian ☐

38. The matrix $\frac{1}{\sqrt{3}} \begin{vmatrix} 1 & 1+i \\ 1-i & -1 \end{vmatrix}$

is ☐

(a) Hermitian ☐

(b) Skew Hermitian ☐

(c) Orthogonal ☐

(d) Unitary ☐

39. The product of two orthogonal matrices is a ☐ matrix.

(a) Unitary ☐

(b) Unit ☐

(c) Orthogonal ☐

(d) None of the above ☐

40. The product of two Unitary matrices is a ☐ matrix.

(a) Unit ☐

(b) Unitary ☐

(c) Orthogonal ☐

(d) None of the above. ☐

41. A skew symmetric matrix cannot be of rank ☐

(a) 1 ☐

(b) 2 ☐

(c) 3 ☐

(d) 6 ☐

42. The points (x_1, y_1) , (x_2, y_2) , (x_3, y_3) are collinear if the rank of the matrix

$$\begin{bmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{bmatrix} \text{ is}$$

(a) 3 ☐

(b) 3 or 2 ☐

(c) 2 or 1 ☐

(d) 3 or 2 or 1. ☐

43. A necessary condition for the linear equations $a_1x+b_1=0$ and $a_2x+b_2=0$, to have a common solution is that

(a) $a_1b_2+a_2b_1=0$ ☐

(b) $a_1b_2-a_2b_1=0$ ☐

(c) $a_1a_2+b_1b_2=0$ ☐

(d) $a_1a_2-b_1b_2=0$ ☐

44. A necessary and sufficient condition for the linear equations $a_1x+b_1y+c_1=0$ and $a_2x+b_2y+c_2=0$ to possess a unique solution is that

(a) $a_1a_2+b_1b_2=0$ ☐

(b) $a_1a_2+b_1b_2 \neq 0$ ☐

(c) $a_1b_2-a_2b_1 \neq 0$ ☐

(d) $a_1b_2+a_2b_1 \neq 0$ ☐

45. The value of the determinant

$$\begin{vmatrix} 3 & 4 \\ 1 & 7 \end{vmatrix} \text{ is}$$

- (a) 31 ☐
 (b) -25 ☐
 (c) 19 ☐
 (d) 17 ☐

46. Which of the following statements is incorrect?

- (a) Transposition leaves the value of the determinant unchanged. ☐
 (b) If two rows of a determinant are proportional, the value of the determinant is zero ☐
 (c) If two rows of a determinant are interchanged, the value of the determinant so obtained is same as the value of the original determinant ☐
 (d) If the elements of any row of a determinant are multiplied by the same number k (say), then the value of the determinant so obtained is k times the value of the original determinant. ☐

47. If a, b, h are real numbers, then the roots of the equation

$$\begin{vmatrix} a-x & h \\ h & b-x \end{vmatrix} = 0 \text{ are}$$

- (a) All real ☐
 (b) All imaginary ☐
 (c) Equal ☐
 (d) One real and the other imaginary ☐

48. $\begin{vmatrix} a_1+c_1 & b_1 \\ a_2+c_2 & b_2 \end{vmatrix}$ can be written as a sum of determinants

- (a) Two ☐
 (b) Three ☐
 (c) Four ☐
 (d) None of the above ☐

49. The value of the determinant of fourth order is the sum of terms.

- (a) Four ☐
 (b) Eight ☐
 (c) Twelve ☐
 (d) Twenty four ☐

$$50. \begin{vmatrix} a & b \\ -b & a \end{vmatrix} \times \begin{vmatrix} c & d \\ -d & c \end{vmatrix} =$$

- (a) $\begin{vmatrix} ac+bd & -ad+bc \\ -bc+ad & bd+ac \end{vmatrix}$ ☐
 (b) $\begin{vmatrix} -ad+bc & -bc+ad \\ ac+bd & bd+ac \end{vmatrix}$ ☐
 (c) $\begin{vmatrix} ac-bd & ad+bc \\ -bc-ad & -bd+ac \end{vmatrix}$ ☐
 (d) None of the above ☐

$$51. \text{ The value of } \begin{vmatrix} 67 & 19 & 21 \\ 39 & 13 & 14 \\ 81 & 24 & 26 \end{vmatrix} \text{ is}$$

- (a) -63 ☐
 (b) 20 ☐
 (c) -43 ☐
 (d) None of the above ☐

52. The values of the minors of the elements of the first row of the determinant

$$\begin{vmatrix} 2 & -1 & 4 \\ 4 & 2 & -3 \\ 1 & 1 & 2 \end{vmatrix} \text{ are respectively}$$

- (a) 2, 7, 11 ☐
 (b) 7, 11, 2 ☐
 (c) 11, 2, 7 ☐
 (d) 7, 2, 11 ☐

53. If the system of linear equations

$$a_1x + b_1y + c_1 = 0$$

$$a_2x + b_2y + c_2 = 0$$

$$a_3x + b_3y + c_3 = 0$$

is consistent (i.e. it possesses a common solution) then

(a) $a_1b_2 - a_2b_1 \neq 0$, $a_2b_3 - a_3b_2 \neq 0$ ☐

(b) $b_1c_2 - b_2c_1 \neq 0$, $b_2c_3 - b_3c_2 \neq 0$ ☐

(c) $\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = 0$ ☐

(d) none of the above ☐

54. The given system of equations

$$a_1x + b_1y + c_1 = 0,$$

$$a_2x + b_2y + c_2 = 0,$$

$$a_3x + b_3y + c_3 = 0;$$

ii $\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = 0$

(a) Is consistent ☐

(b) Is inconsistent ☐

(c) May or may not be consistent ☐

(d) Is consistent and has infinitely many solutions ☐

55. The system of equations

$$x + 2y + 3z = 0,$$

$$3x + 4y + 4z = 0,$$

$$7x + 10y + 12z = 0;$$

(a) Possesses a trivial solution only ☐

(b) Possesses a non zero unique solution ☐

(c) Does not have a common non zero solution ☐

(d) Has infinitely many solutions ☐

56. The given system of equations

$$x + y + z - 7 = 0$$

$$x + 2y + 3z - 16 = 0$$

$$x + 3y + 4z = 22$$

(a) Has a unique not zero solution ☐

(b) Does not have any non-zero solution ☐

(c) Has infinitely many non-zero solutions ☐

(d) Is inconsistent ☐

57. Give an example of a system of equations of the type

$$a_1x + b_1y + c_1 = 0,$$

$$a_2x + b_2y + c_2 = 0,$$

$$a_3x + b_3y + c_3 = 0;$$

for which $\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = 0$, but the

system has no non zero common solution.

(a) $x + 2y - 3 = 0$

$$2x - 3y + 1 = 0$$

$$3x - 7y + 4 = 0$$

(b) $3x + 5y + 7 = 0$

$$4x - y - 6 = 0$$

$$5x + 2y - 1 = 0$$

(c) $x + 2y + 1 = 0$

$$2x + 4y + 3 = 0$$

$$5x + 10y + 7 = 0$$

(d) None of the above ☐

58. Every skew symmetric determinant of odd order is always

(a) Equal to one ☐

(b) Equal to zero ☐

(c) A perfect square ☐

(d) A perfect cube ☐

59. Every skew-symmetric determinant of even order is

- (a) Equal to zero ☐
 (b) Equal to one ☐
 (c) A perfect square ☐
 (d) None of the above ☐

60. If a matrix B is obtained by taking the transpose of the matrix of co-factors of corresponding elements of the matrix A , then B is called the

- (a) Inverse of A ☐
 (b) Adjoint of A ☐
 (c) Rank of A ☐
 (d) None of the above ☐

61. Which of the following statements is incorrect?

- (a) If A is any square matrix and B is the transpose of the matrix of co-factors of corresponding elements of the matrix A , then B is called the adjoint of A ☐
 (b) If A is any square matrix, then $(\text{adj. } A)A = A(\text{adj. } A) = |A|$ ☐
 (c) A square matrix A is invertible iff $|A| \neq 0$ ☐
 (d) Every square non singular matrix possesses a unique inverse ☐

62. Which of the following statements is incorrect?

If A and B are any non singular matrices, then

- (a) AB is invertible ☐
 (b) A^T is invertible ☐
 (c) A^* may or may not be invertible where A^* is the transposed conjugate of A ☐
 (d) The statements (a), (b) and (c) are not all correct ☐

63. Which of the following statement is incorrect?

- If A and B are non singular matrices then
 (a) $(AB)^{-1} = A^{-1}B^{-1}$ ☐

(b) $(A^T)^{-1} = (A^{-1})^T$ ☐

(c) $(A^*)^{-1} = (A^{-1})^*$ ☐

(d) The statement (a), (b) and (c) are not all correct ☐

64. Which of the following statements is correct?

(a) If A is triangular, A^{-1} is also triangular ☐

(b) If A is any matrix, then $\text{adj. } A^T = \text{adj. } A$ ☐

(c) If A and B are square matrices of order n , then $\text{adj. } (AB) = (\text{adj. } A)(\text{adj. } B)$ ☐

(d) All the statements (a), (b) and (c) are incorrect ☐

65. If $A = \begin{bmatrix} 1 & 2 & 3 \\ 3 & 4 & 5 \\ 4 & 5 & 6 \end{bmatrix}$ and $\rho(A)$ de-

notes the rank of A , then $\rho(A)$ is equal to

- (a) 1 ☐
 (b) 2 ☐
 (c) 3 ☐
 (d) $\rho(A)$ does not exist ☐

66. If a matrix, A of order $m \times n$ is reducible to the form

$\begin{bmatrix} I_r & 0 \\ 0 & 0 \end{bmatrix}$, where $r < m$

and $r < n$, then $\rho(A)$ is

- (a) $m-r$ ☐
 (b) $n-r$ ☐
 (c) r ☐
 (d) Less than r ☐

67. Mark the correct statement

If A and B are any two matrices of order $m \times n$, then

- (a) $\rho(A+B) = \rho(A) + \rho(B)$ ☐
 (b) $\rho(A+B) \leq \rho(A) + \rho(B)$ ☐
 (c) $\rho(AB) = \rho(A) = \rho(B)$ ☐
 (d) $\rho(A) + \rho(B) \geq 3$ ☐

68. If there is a non-zero minor of order r of the matrix A , then

- (a) $\rho(A)=r$ ☐
 (b) $\rho(A)<r$ ☐
 (c) $\rho(A)$ is not less than r ☐
 (d) $\rho(A)>r$ ☐

69. If all the minors of order $r+1$ of the matrix A are zero, then

- (a) $\rho(A)=r$ ☐
 (b) $\rho(A)<r$ ☐
 (c) $\rho(A)>r$ ☐
 (d) $\rho(A)$ is not greater than r ☐

70. The system of equations

$$4x+5y+6z=0,$$

$$5x+6y+7z=0,$$

$$7x+8y+9z=0;$$
 is

- (a) Homogeneous and possesses trivial solution only ☐
 (b) Non-homogeneous, consistent and has a unique solution ☐
 (c) Homogeneous and has a non-trivial solution ☐
 (d) Non-homogeneous, consistent but does not possess a unique solution ☐

71. If A is a 3×3 non-singular matrix and B is a 3×3 non zero singular matrix in which every minor of order 2 is zero, then $\rho(AB)=$

- (a) 1 ☐
 (b) 3 ☐
 (c) 6 ☐
 (d) 9 ☐

72. If $A = \begin{bmatrix} -1 & 2 \\ 3 & -5 \end{bmatrix}$, then $A^{-1} =$

- (a) $\begin{bmatrix} 5 & 1 \\ 2 & 3 \end{bmatrix}$ ☐
 (b) $\begin{bmatrix} 5 & 3 \\ 2 & 1 \end{bmatrix}$ ☐

(c) $\begin{bmatrix} 5 & 2 \\ 3 & 1 \end{bmatrix}$ ☐

(d) $\begin{bmatrix} -5 & -2 \\ -3 & -1 \end{bmatrix}$ ☐

73. If A is a square matrix, then

- (a) $|AA^*| = |A|^2$ ☐
 (b) $|AA^*| = -|A|^2$ ☐
 (c) $|AA^T| = |A|^2$ ☐
 (d) $|AA^T| = -|A|^2$ ☐

74. An $m \times n$ matrix is a square matrix if

- (a) $m^2=n$ ☐
 (b) $n^3=m$ ☐
 (c) $m^2=n^2$ ☐
 (d) None of above ☐

75. If A and B are any two square matrices, then— is a skew symmetric matrix

- (a) $\frac{A+A^T}{2}$ ☐
 (b) $\frac{A^T+B^T}{2}$ ☐
 (c) $\frac{A^T-B^T}{2}$ ☐
 (d) $\frac{B-B^T}{2}$ ☐

76. A unit matrix of order n is of rank

- (a) 0 ☐
 (b) 1 ☐
 (c) n ☐
 (d) None of the above ☐

77. The rank of $\begin{bmatrix} 1 & 2 & 3 \\ 1 & 2 & 4 \\ 1 & 2 & 3 \end{bmatrix}$ is

- (a) 0 ☐
 (b) 1 ☐

(c) 2

(d) 3

78. The multiplicative identity of the set of all 2×2 matrices is

(a) $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

(b) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

(c) $\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$

(d) $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$

79. The matrix $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ has

(a) The value -2

(b) The value 2

(c) The value 4

(d) No value

80. The equations $a_1x + b_1y + c_1z = d_1$

$$a_2x + b_2y + c_2z = d_2$$

$$a_3x + b_3y + c_3z = d_3$$

are consistent if

(a) $\rho(A) < \rho(A, B)$

(b) $\rho(A) > \rho(A, B)$

(c) $\rho(A) = \rho(A, B)$

(d) Any one of (a) and (b) holds

Note : In Ques. 80,

$$A = \begin{bmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{bmatrix}$$

and $(A, B) = \begin{bmatrix} a_1 & b_1 & c_1 & d_1 \\ a_2 & b_2 & c_2 & d_2 \\ a_3 & b_3 & c_3 & d_3 \end{bmatrix}$

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81. If A is an $m \times n$ matrix and $\rho(A) = r$, then $AX = 0$ has a non-trivial solution if

(a) $n = r$

(b) $r < n$

(c) $r > n$

(d) $r \leq n$

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82. If $\alpha = 2$ and

$$A = \begin{bmatrix} 1 & 2 & 0 & 3 \\ 2 & 0 & 1 & 2 \\ 1 & 0 & 1 & 0 \end{bmatrix}, \text{ then } \alpha A =$$

(a) $\begin{bmatrix} 2 & 2 & 0 & 3 \\ 4 & 0 & 1 & 2 \\ 2 & 0 & 1 & 0 \end{bmatrix}$

(b) $\begin{bmatrix} 2 & 4 & 0 & 6 \\ 2 & 0 & 1 & 2 \\ 1 & 0 & 1 & 0 \end{bmatrix}$

(c) $\begin{bmatrix} 2 & 4 & 0 & 6 \\ 4 & 0 & 1 & 4 \\ 2 & 0 & 2 & 0 \end{bmatrix}$

(d) $\begin{bmatrix} 2 & 4 & 0 & 6 \\ 4 & 0 & 2 & 4 \\ 2 & 0 & 2 & 0 \end{bmatrix}$

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83. If A and B are two matrices then both $A+B$ and $A \cdot B$ exist if

(a) A and B are of the same type

(b) A and B are square matrices

(c) None of (a) and (b)

(d) Both of (a) and (b)

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84. The value of the determinant

$$\begin{vmatrix} ka_1 & ka_2 & ka_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{vmatrix} \text{ is}$$

(a) $k + (a_1 b_2 c_3)$

(b) $k \cdot (a_1 b_2 c_3)$

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(c) $k^3(a_1 b_2 c_3)$ ☐

(d) $3k(a_1 b_2 c_3)$ ☐

Note: Here $(a_1 b_2 c_3)$ denotes the determinant

$$\begin{vmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{vmatrix}$$

85. The determinant

$$\begin{vmatrix} 1 & 1 & 1 \\ 1 & 2 & 3 \\ 1 & 3 & 6 \end{vmatrix}$$

is not equivalent to

(a) $\begin{vmatrix} 3 & 1 & 1 \\ 5 & 2 & 3 \\ 7 & 3 & 6 \end{vmatrix}$ ☐

(b) $\begin{vmatrix} 2 & 1 & 1 \\ 2 & 2 & 3 \\ 2 & 3 & 6 \end{vmatrix}$ ☐

(c) $\begin{vmatrix} 1 & 2 & 1 \\ 1 & 5 & 3 \\ 1 & 9 & 6 \end{vmatrix}$ ☐

(d) $\begin{vmatrix} 2 & 1 & 1 \\ 3 & 2 & 3 \\ 4 & 3 & 6 \end{vmatrix}$ ☐

86. Which of the following determinants is different from others

(a) $(a_1 b_2 c_3)$ ☐

(b) $(b_1 c_2 a_3)$ ☐

(c) $(a_3 b_1 c_2)$ ☐

(d) $(a_3 b_1 c_3)$ ☐

87. Cofactor of c_2 in the determinant

$$\begin{vmatrix} a_1 & a_2 & a_3 & a_4 \\ b_1 & b_2 & b_3 & b_4 \\ c_1 & c_2 & c_3 & c_4 \\ d_1 & d_2 & d_3 & d_4 \end{vmatrix} \text{ is}$$

(a) $(a_1 b_3 c_3)$ ☐

(b) $-(a_1 b_3 d_4)$ ☐

(c) $(a_2 b_3 d_4)$ ☐

(d) $-(a_1 b_1 c_3)$ ☐

88. $\begin{vmatrix} a+b & c & d \\ a_1+b_1 & c_1 & d_1 \\ a_2+b_2 & c_2 & d_2 \end{vmatrix}$

(a) $(ab_1c_2)+(ab_1d_2)$ ☐

(b) $(ac_1b_2)+(ad_1b_2)$ ☐

(c) $(ad_1c_2)+(bc_1d_2)$ ☐

(d) $(ac_1d_2)+(bc_1d_2)$ ☐

89. If A_{ij} denotes the cofactor of the element a_{ij} of the determinant $\Delta = |a_{ij}|$, then value of $a_{11}A_{21} + a_{12}A_{22} + \dots + a_{1n}A_{2n}$ is equal to

(a) Δ ☐

(b) 0 ☐

(c) 1 ☐

(d) $-\Delta$ ☐

90. If A is any square matrix of order n then $\text{Adj}(\text{Adj} A) =$

(a) $|A|^{n-1}A$ ☐

(b) $|A|^{n-2}A$ ☐

(c) $|A|^{n-2}A$ ☐

(d) $|A^n|I$ ☐

91. If A is any square matrix of order n , then $|\text{Adj} A| =$

(a) $|A|^{n-1}$ ☐

(b) $|A|^n$ ☐

(c) $|A|$ ☐

(d) $|A|^{n-2}$ ☐

92. Given $x+2y+3z=6$
 $2x+4y+z=7$
 $3x+2y+9z=14,$

the value of x is given by

(a) $\begin{vmatrix} 6 & 2 & 3 \\ 7 & 4 & 1 \\ 14 & 2 & 9 \end{vmatrix}$

(b) $\begin{vmatrix} 6 & 2 & 3 \\ 7 & 4 & 1 \\ 14 & 2 & 9 \end{vmatrix}$

$\begin{vmatrix} 1 & 2 & 3 \\ 2 & 4 & 1 \\ 3 & 2 & 9 \end{vmatrix}$

(c) $\begin{vmatrix} 1 & 2 & 3 \\ 2 & 4 & 1 \\ 3 & 2 & 9 \end{vmatrix}$

$\begin{vmatrix} 6 & 2 & 3 \\ 7 & 4 & 1 \\ 14 & 2 & 9 \end{vmatrix}$

(d) $\begin{vmatrix} 1 & 2 & 3 \\ 2 & 4 & 1 \\ 3 & 2 & 9 \end{vmatrix}$

93. The leading diagonal of the determinant

$\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$ is

(a) $(a_1 b_2 c_3)$

(b) $(c_1 b_2 a_3)$

(c) $(a_1 a_2 a_3)$

(d) $(a_1 b_2 a_3)$

94. The determinant

$\begin{vmatrix} a & b & c \\ d & e & f \\ g & h & k \end{vmatrix} \times \begin{vmatrix} a & b & c \\ d & e & f \\ g & h & k \end{vmatrix}$ is

a determinant of order

(a) 3

(b) 6

(c) 9

(d) 27

95. If A and B are two square matrices each of order 3, then

(a) $\frac{A}{B}$ may or may not have a meaning

(b) $\frac{A}{B}$ means AB^{-1}

(c) $\frac{A}{B}$ means $B^{-1}A$

(d) $\frac{A}{B} = AB^{-1} = B^{-1}A$

96. Let A be any matrix. Which of the following represents a number?

(a) A^{-1}

(b) $\text{Adj}(A)$

(c) $\rho(A)$, rank of A

(d) A

97. Which of the following is not used in calculating the inverse of a non-singular matrix?

(a) Characteristic Equation

(b) Minors

(c) Adjoint

(d) Rank

98. Who among the following is associated with a technique of solving a system of linear equations?

(a) Sarrus

(b) Cayley

- (c) Cramer ☐
 (d) Hermite ☐

99. Who is associated with matrix theory?

- (a) Newton ☐
 (b) Cauchy ☐
 (c) Hamilton ☐
 (d) Euclid. ☐

100. One of the following terms differs in nature from the other three. Mark it.

- (a) Unit ☐
 (b) Triangular ☐
 (c) Singular ☐
 (d) Diagonal ☐

101. Mark the incorrect statement? Let D be a 3×3 diagonal matrix. Then

- (a) $D^T = D$ ☐
 (b) $AD = DA$ for all 3×3 matrices A ☐
 (c) DA is a diagonal matrix for all 3×3 diagonal matrices A ☐
 (d) D^{-1} , if it exists, is diagonal. ☐

102. $\begin{bmatrix} 1 & \sqrt{2} & \sqrt{3} \\ 0 & 1 & -1 \end{bmatrix}$ is a 2×3 matrix

over the set of

- (a) Natural numbers ☐
 (b) Rational numbers ☐
 (c) Real numbers ☐
 (d) Complex numbers ☐

103. The matrices

$\begin{bmatrix} 3 & 1 & 7 \\ 8 & 9 & 1 \end{bmatrix}$ and $\begin{bmatrix} \sqrt{9} & 3-2 & 7 \\ 2^3 & 3^2 & 1^2 \end{bmatrix}$ are

- (a) Comparable ☐
 (b) Equal ☐
 (c) Both of the above ☐
 (d) None of the above ☐

104. $\cos \theta \begin{bmatrix} \cos \theta & \sin \theta \\ \sin \theta & \cos \theta \end{bmatrix}$

$+ \sin \theta \begin{bmatrix} \sin \theta & -\cos \theta \\ \cos \theta & \sin \theta \end{bmatrix}$ is equal to

- (a) 0 ☐
 (b) 1 ☐
 (c) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ ☐

(d) None of the above. ☐

105. If $\sigma_x = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$, $\sigma_y = \begin{bmatrix} 0 & -i \\ i & 0 \end{bmatrix}$,

$\sigma_z = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$ and $I_2 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ then

- (a) $\sigma_x \sigma_x = I_2 = \sigma_y \sigma_y = \sigma_z \sigma_z$ ☐
 (b) $\sigma_x \sigma_y = \sigma_y \sigma_x$ ☐
 (c) $\sigma_y \sigma_z = \sigma_z \sigma_y$ ☐
 (d) $\sigma_z \sigma_x = \sigma_x \sigma_z$ ☐

Note : σ_x , σ_y and σ_z are called Pauli-Spin matrices.

106. If

$A = \begin{bmatrix} -1 & 2 \\ 2 & 3 \end{bmatrix}$, $B = \begin{bmatrix} 3 & 0 \\ 1 & 1 \end{bmatrix}$; then

$(A+B)^2 =$

- (a) $A^2 + 2AB + B^2$ ☐
 (b) $A^2 + AB + BA + B^2$ ☐
 (c) Both of (a) and (b) ☐
 (d) None of the above. ☐

107. If A is any $m \times n$ matrix and I_m denotes the m -rowed unit matrix, then

- (a) $AI_m = A = AI_n$ ☐
 (b) $I_m A = A = I_n A$ ☐
 (c) $I_m A = AI_n = A$ ☐
 (d) $AI_m = A = I_n A$ ☐

108. Which of the following statements is wrong?

- (a) An elementary row operation on the product of two matrices is equivalent to the same elementary row operation on the pre-factor ☐
- (b) An elementary column operation on the product of two matrices is equivalent to the same column operation on the pre factor ☐
- (c) Every elementary row operation on a matrix is equivalent to pre-multiplication by the elementary matrix corresponding to that operation ☐
- (d) Every elementary column operation on a matrix is equivalent to post multiplication by the elementary matrix corresponding to that operation. ☐

109. Let $A = \begin{bmatrix} 2 & 1 & -1 \\ 7 & 0 & 6 \\ 1 & 3 & -2 \end{bmatrix}$,

$$B = \begin{bmatrix} 2 & 5 \\ 1 & 1 \\ -1 & 2 \end{bmatrix}$$

If C is the matrix obtained from AB and D is the matrix obtained from A by the elementary operation $R_2 \leftrightarrow R_3$, then

- (a) $D = CB$ ☐
- (b) $D = CA$ ☐
- (c) $C = DA$ ☐
- (d) $C = DB$ ☐

110. If A and B are two matrices such that $AB = A$ and $BA = B$, then

- (a) A is idempotent but B is not ☐
- (b) B is idempotent but A is not ☐
- (c) A and B both are involutory ☐
- (d) A and B both are idempotent ☐

111. The matrix

$$\begin{bmatrix} 4 & -1 & -4 \\ 3 & 0 & -4 \\ 3 & -1 & -3 \end{bmatrix} \text{ is}$$

- (a) Idempotent ☐
- (b) Nilpotent of order 3 ☐
- (c) Involutory ☐
- (d) None of the above. ☐

112. The matrix

$$A = \begin{bmatrix} ab & b^2 \\ -a^2 & -ab \end{bmatrix} \text{ is}$$

- (a) Idempotent ☐
- (b) Nilpotent of order 2 ☐
- (c) Involutory ☐
- (d) None of the above. ☐

113. If A and B are n -rowed square matrices, then AB is symmetric iff

- (a) A and B both are symmetric ☐
- (b) A and B both are anti-symmetric ☐
- (c) A and B both commute ☐
- (d) A and B both anti-commute. ☐

114. The matrix B^*AB is Hermitian only if

- (a) A is Hermitian ☐
- (b) B is Hermitian ☐
- (c) A is skew Hermitian ☐
- (d) B is skew Hermitian ☐

115. Pauli-Spin Matrices are all

- (a) Symmetric ☐
- (b) Skew Symmetric ☐
- (c) Orthogonal ☐
- (d) Unitary. ☐

116. The matrix

$$\frac{1}{3} \begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & -2 \\ -2 & 2 & -1 \end{bmatrix} \text{ is}$$

- (a) Unitary ☐
 (b) Orthogonal ☐
 (c) Symmetric ☐
 (d) None of the above. ☐

117. If D is the determinant of $n \times n$ matrix A , A_1 is the adjoint of A and A_2 is the adjoint of A_1 , then

- (a) $A_1 = D^n A$ ☐
 (b) $A_1 A_2 = D I_n$ ☐
 (c) $A_2 = D^n A_1$ ☐
 (d) $A_2 = D^{n-2} A$ ☐

118. Which of the following statements is incorrect?

- (a) If k is any scalar and I_n is the unit matrix of order n , then $\text{adj.}(kI_n) = k^n I_n$ ☐
 (b) The adjoint of a triangular matrix is triangular ☐
 (c) If A is any non-singular matrix then $AB = AC \Rightarrow B = C$ ☐
 (d) If A is any non-singular symmetric matrix, then A^{-1} is also symmetric. ☐

119. Which of the following statements is incorrect?

If A and B are non-singular symmetric matrices and $AB = BA$, then

- (a) $A^{-1}B$ is symmetric ☐
 (b) AB^{-1} is symmetric ☐
 (c) $A^{-1}B^{-1}$ is symmetric ☐
 (d) AB is symmetric ☐

120. If A denotes a 4×5 matrix, then which one of the following represents a null set?

- (a) The totality of matrices equivalent to A ☐
 (b) The totality of elements of A ☐
 (c) The totality of matrices similar of A ☐
 (d) The totality of characteristic roots of A . ☐

121. If $A = \begin{bmatrix} 1 & 2 & 3 \\ 1 & 2 & 5 \\ 2 & 4 & 8 \end{bmatrix}$,

$B = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & -8 \end{bmatrix}$, $C = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$

$D = \begin{bmatrix} -5 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ then

$\rho(ABCD)$ is equal to

- (a) 1 ☐
 (b) 2 ☐
 (c) 4 ☐
 (d) 8 ☐

122. If A is a 3×3 matrix with rank 2 and B is a 3×3 matrix with rank 3, then $\rho(AB) =$

- (a) 1 ☐
 (b) 2 ☐
 (c) 3 ☐
 (d) 6 ☐

123. The matrix

$A = \begin{bmatrix} \frac{1}{\sqrt{2}} & \frac{i}{\sqrt{2}} \\ -\frac{i}{\sqrt{2}} & -\frac{1}{\sqrt{2}} \end{bmatrix}$ is

- (a) Orthogonal ☐
 (b) Singular ☐
 (c) Nilpotent of order 2 ☐
 (d) Involutory ☐

124. Which of the following statements is incorrect?

If A is a non-singular matrix, then

- (a) A is symmetric matrix $\Rightarrow A^{-1}$ is symmetric matrix ☐

(b) A is diagonal matrix $\Rightarrow A^{-1}$ is also diagonal matrix ☐

(c) A is scalar matrix $\Rightarrow A^{-1}$ is also scalar matrix ☐

(d) $|A| = 2 \Rightarrow |A^{-1}| = \frac{1}{2}$ ☐

125. The matrix

$$\begin{bmatrix} 0 & 4+i & 3 \\ -4+i & 3i & 2i \\ 3 & 2i & -i \end{bmatrix} \text{ is}$$

(a) Symmetric ☐

(b) Skew-symmetric ☐

(c) Hermitian ☐

(d) Skew Hermitian ☐

126. The matrix

$$\begin{bmatrix} 0 & 5 & -2 \\ -5 & 0 & -3i \\ 2 & 3i & 0 \end{bmatrix} \text{ is}$$

(a) Symmetric ☐

(b) Skew-symmetric ☐

(c) Hermitian ☐

(d) Skew Hermitian ☐

127. If A and B are matrices of order 3×2 and C is a matrix of order 2×3 , then ——— is not defined.

(a) $A^T + B$ ☐

(b) $A^T + B^T$ ☐

(c) $A^T + C$ ☐

(d) $B + C^T$ ☐

128. The matrix $\begin{bmatrix} 1 & 1 & 3 \\ 5 & 2 & 6 \\ -2 & -1 & -3 \end{bmatrix}$ is

(a) Nilpotent of order 2 ☐

(b) Nilpotent of order 3 ☐

(c) Not nilpotent ☐

(d) Idempotent ☐

129. The matrix $A = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ is not

(a) Idempotent ☐

(b) The inverse of itself ☐

(c) Involutory ☐

(d) Nilpotent ☐

130. The matrix $\begin{bmatrix} 0 & 5 & -5 \\ -5 & 0 & 5 \\ 5 & -5 & 0 \end{bmatrix}$ is

(a) Diagonal matrix ☐

(b) Skew-symmetric and Hermitian ☐

(c) Symmetric and Skew Hermitian ☐

(d) Skew-symmetric and Skew Hermitian ☐

131. The matrix $\begin{bmatrix} 4 & 2i & 4+i \\ -2i & 3 & i \\ 4-i & i & 0 \end{bmatrix}$ is

(a) Skew-symmetric ☐

(b) Hermitian ☐

(c) Skew Hermitian ☐

(d) None of the above. ☐

132. The maximum number of different possible nonzero entries in a skew symmetric matrix of order n is

(a) $\frac{1}{2}(n^2 - n)$ ☐

(b) $\frac{1}{2}(n^2 + n)$ ☐

(c) n^2 ☐

(d) None of the above ☐

133. The maximum number of different possible nonzero entries in a symmetric matrix of order n is

(a) $\frac{1}{2}(n^2 + n)$ ☐

(b) $\frac{1}{2}(n^2 - n)$ ☐

(c) n^2

(d) None of the above.

134. The rank of the matrix

$$A = \begin{bmatrix} 1 & 1 & 0 \\ 1 & 1 & 0 \\ 1 & 1 & 0 \end{bmatrix} \text{ is}$$

(a) 0

(b) 1

(c) 2

(d) 3

135. The matrix

$$\begin{bmatrix} 2 & 2 & 3 \\ 6 & 4 & 2 \\ 1 & 2 & 3 \end{bmatrix},$$

can be obtained from

$$\begin{bmatrix} 2 & 2 & 3 \\ 3 & 2 & 1 \\ 1 & 2 & 3 \end{bmatrix} \text{ by}$$

(a) Elementary row operations only

(b) Elementary column operations only

(c) Elementary operations (row and column both)

(d) None of the above

136. If A, B, C, F, G, H , denote respectively the cofactors of a, b, c, f, g, h in the

$$\text{determinant } \begin{bmatrix} a & h & g \\ h & b & f \\ g & f & c \end{bmatrix} \text{ then}$$

(a) $GH - AF = \Delta$ (b) $AF - GH = f\Delta$ (c) $AF - GH = \Delta$ (d) $GH - AF = f\Delta$

137. The equations

$$x + y + z = 3,$$

$$2x - 3y + 2z = 1$$

and

$$3x - 2y + 3z = 7 \text{ are}$$

(a) Inconsistent

(b) Consistent and have a unique solution

(c) Consistent and do not have a unique solution

(d) None of the above

138. When every element of a n th order determinant Δ is multiplied by a number K , then the value of the determinant

(a) Is unaltered

(b) Becomes $K\Delta$ (c) Becomes $nK\Delta$ (d) Becomes $K^n\Delta$ 139. If A and B are matrices such that $\rho(AB) = \rho(A)$, then(a) B is singular(b) B is nonsingular(c) Number of rows in B equals number of columns in A .

(d) None of the above

140. Which of the following is not a skew symmetric/symmetric determinant?

$$(a) \begin{bmatrix} 0 & -1 & b \\ -1 & 0 & a \\ h & a & 0 \end{bmatrix}$$

$$(b) \begin{bmatrix} 1 & -1 & b \\ -1 & 1 & a \\ b & a & 1 \end{bmatrix}$$

$$(c) \begin{bmatrix} 0 & 1 & b \\ -1 & 0 & a \\ -b & -a & 0 \end{bmatrix}$$

$$(d) \begin{bmatrix} 1 & 1 & b \\ -1 & 1 & a \\ -b & -a & 1 \end{bmatrix}$$

141. The equations

$$x+y=2$$

$$4x+3y=7$$

$$x-2y=1$$
 are

- (a) Inconsistent ☐
 (b) Consistent but have many solutions ☐
 (c) Consistent and have unique solution ☐
 (d) Consistent but does not have any solution ☐

142. If A and B are square matrices of the same order, then

- (a) $\text{Adj.}(AB) = (\text{Adj. } A)(\text{Adj. } B)$ ☐
 (b) $(A+B)^{-1} = A^{-1} + B^{-1}$ ☐
 (c) A and B are non-zero and $AB=0 \Rightarrow$ exactly one of $|A|$ and $|B|$ is zero ☐
 (d) A and B are non-zero and $AB=0 \Rightarrow |A|=0$ and $|B|=0$ ☐

143. Which one of the following statements is correct?

- (a) If A and B are matrices such that AB exists and is zero matrix, then

either A or B is a zero matrix i.e. $AB=0 \Rightarrow$ either $A=0$ or $B=0$ ☐

- (b) If A and B are square matrices of the same order, then

$$(A+B)^2 = A^2 + 2AB + B^2$$
 ☐

- (c) If A , B and C are comparable matrices such that $A+B=A+C$, then $B=C$ ☐

- (d) If A and B are square matrices of the same order, then

$$(A+B)(A-B) = A^2 - B^2$$
 ☐

144. $A(\text{Adj. } A)$ is a

- (a) Zero matrix ☐
 (b) Unit matrix ☐
 (c) Scalar matrix ☐
 (d) None of the above ☐

145. The matrix $B'AB$ is symmetric (skew symmetric) according as

- (a) A is symmetric (skew symmetric) ☐
 (b) A is skew symmetric (symmetric) ☐
 (c) A is Hermitian (skew Hermitian) ☐
 (d) A is skew Hermitian (Hermitian) ☐

ANSWERS

- | | | | | | |
|-------|-------|-------|-------|-------|-------|
| 1. c | 2. d | 3. a | 34. a | 35. d | 36. b |
| 4. b | 5. d | 6. c | 37. b | 38. d | 39. c |
| 7. b | 8. c | 9. d | 40. b | 41. a | 42. c |
| 10. c | 11. c | 12. c | 43. b | 44. c | 45. d |
| 13. a | 14. a | 15. c | 46. c | 47. a | 48. a |
| 16. a | 17. b | 18. a | 49. d | 50. c | 51. c |
| 19. c | 20. d | 21. c | 52. b | 53. c | 54. c |
| 22. a | 23. b | 24. b | 55. c | 56. a | 57. c |
| 25. a | 26. d | 27. b | 58. b | 59. c | 60. b |
| 28. c | 29. d | 30. a | 61. b | 62. c | 63. a |
| 31. b | 32. b | 33. c | 64. d | 65. b | 66. c |

67. <i>b</i>	68. <i>c</i>	69. <i>d</i>	109. <i>d</i>	110. <i>d</i>	111. <i>c</i>
70. <i>c</i>	71. <i>a</i>	72. <i>c</i>	112. <i>b</i>	113. <i>c</i>	114. <i>a</i>
73. <i>c</i>	74. <i>d</i>	75. <i>d</i>	115. <i>d</i>	116. <i>b</i>	117. <i>d</i>
76. <i>c</i>	77. <i>c</i>	78. <i>b</i>	118. <i>a</i>	119. <i>d</i>	120. <i>d</i>
79. <i>d</i>	80. <i>c</i>	81. <i>b</i>	121. <i>b</i>	122. <i>b</i>	123. <i>d</i>
82. <i>d</i>	83. <i>b</i>	84. <i>b</i>	124. <i>d</i>	125. <i>d</i>	126. <i>b</i>
85. <i>b</i>	86. <i>d</i>	87. <i>c</i>	127. <i>a</i>	128. <i>b</i>	129. <i>d</i>
88. <i>d</i>	89. <i>b</i>	90. <i>c</i>	130. <i>d</i>	131. <i>d</i>	132. <i>b</i>
91. <i>b</i>	92. <i>b</i>	93. <i>a</i>	133. <i>c</i>	134. <i>b</i>	135. <i>a</i>
94. <i>a</i>	95. <i>a</i>	96. <i>c</i>	136. <i>d</i>	137. <i>a</i>	138. <i>d</i>
97. <i>d</i>	98. <i>c</i>	99. <i>c</i>	139. <i>b</i>	140. <i>d</i>	141. <i>a</i>
100. <i>e</i>	101. <i>b</i>	102. <i>c</i>	142. <i>d</i>	143. <i>c</i>	144. <i>c</i>
103. <i>c</i>	104. <i>c</i>	105. <i>a</i>	145. <i>a</i>		
106. <i>b</i>	107. <i>c</i>	108. <i>b</i>			

Calculus

Section—A

DIFFERENTIAL CALCULUS

1. What is $\frac{0}{0}$?
 - (a) 1 ☐
 - (b) 0 ☐
 - (c) ∞ ☐
 - (d) Any number ☐
2. $\frac{a}{0}$ ($a \neq 0$) is equal to
 - (a) 0 ☐
 - (b) a ☐
 - (c) None of the numbers ☐
 - (d) None of the above ☐
3. $\frac{0}{0}$ is
 - (a) A natural number ☐
 - (b) A rational number ☐
 - (c) An irrational number ☐
 - (d) Indeterminate ☐
4. $\frac{a}{0}$ ($a \neq 0$) is defined as
 - (a) A finite number always ☐
 - (b) Infinity ☐
 - (c) A number which takes finite value in some cases and infinite otherwise ☐
 - (d) None of the above ☐
5. Find the value of $\frac{x^2-36}{x-6}$ at $x=6$
 - (a) 12 ☐
 - (b) 0 ☐
 - (c) Does not exist ☐
 - (d) None of the above ☐
6. The set of all natural numbers is not closed with respect to
 - (a) Multiplication ☐
 - (b) Subtraction ☐
 - (c) Addition ☐
 - (d) All of the above ☐
7. Every rational number is expressible as $\frac{p}{q}$ where
 - (a) p and q are any natural numbers ☐
 - (b) p and q are any integers ☐
 - (c) p and q are any nonzero integers ☐
 - (d) p and q are any integers but $q \neq 0$ ☐
8. Every rational number can be expressed as a
 - (a) Recurring decimal ☐
 - (b) Terminating decimal ☐
 - (c) Recurring or a terminating decimal ☐
 - (d) None of the above ☐
9. There is no rational number whose square is
 - (a) 576 ☐
 - (b) 729 ☐
 - (c) 964 ☐
 - (d) 1089 ☐
10. If p^2 is an even number, then
 - (a) p is even ☐
 - (b) p is odd ☐
 - (c) p may either be even or odd ☐
 - (d) p is prime ☐
11. $\sqrt[3]{2}$ lies between
 - (a) 1 and 1.1 ☐

- (b) 1 and 1.2 ☐
- (c) 1.1 and 1.2 ☐
- (d) 1.2 and 1.3 ☐
12. If x, a and l are any three numbers such that $|x-a| < l$ then x lies between ☐
- (a) $a-l$ and $a+l$ ☐
- (b) $a-l$ and a ☐
- (c) a and $a+l$ ☐
- (d) $-\infty$ and $a+l$ ☐
13. If $|a-b| < l, |b-c| < m$, then $|a-c|$ is ☐
- (a) Equal to $l-m$ ☐
- (b) Less than $l-m$ ☐
- (c) Greater than $l-m$ ☐
- (d) Less than $l+m$ ☐
14. $-3 \leq x \leq 7$ is equivalent to ☐
- (a) $|x-3| \leq 4$ ☐
- (b) $|x-7| \geq -10$ ☐
- (c) $|x-2| \leq 5$ ☐
- (d) None of the above ☐
15. $2 < x < 5$ is equivalent to ☐
- (a) $|x-2| < 3$ ☐
- (b) $|x-7/2| < 3/2$ ☐
- (c) $|x-5| < 2$ ☐
- (d) None of the above ☐
16. $0 < |x-1| < 2$ is equivalent to ☐
- (a) $-1 < x < 1$ ☐
- (b) $1 < x < 3$ ☐
- (c) $-1 < x < 3$ ☐
- (d) None of the above ☐
17. $|x+1| \leq 2$ is equivalent to ☐
- (a) $-1 \leq x \leq 3$ ☐
- (b) $-3 \leq x \leq 1$ ☐
- (c) $-1 \leq x \leq 1$ ☐
- (d) None of the above ☐
18. If $y = |x| + |x-1|$, then for $x \leq 0$ y is equal to ☐
- (a) $2x-1$ ☐
- (b) 1 ☐
- (c) $1-2x$ ☐
- (d) Any positive real number ☐
19. The domain of the function $y = \frac{x}{x}$ is given by the set of all ☐
- (a) Real numbers ☐
- (b) Rational numbers ☐
- (c) Integers ☐
- (d) Natural numbers ☐
20. The domain of definition of the function $\frac{1}{\sqrt{(1-x)(x-2)}}$ is the open interval ☐
- (a) $(-\infty, 1)$ ☐
- (b) $(2, \infty)$ ☐
- (c) $(1, 2)$ ☐
- (d) None of the above ☐
21. The domain of definition of the function $\frac{1}{\sqrt{-x}}$ is ☐
- (a) $(-\infty, \infty)$ ☐
- (b) $(-\infty, 0)$ ☐
- (c) $(0, \infty)$ ☐
- (d) $(-\infty, 0)$ ☐
23. Which of the following sets is not countable? ☐
- (a) The set of integers ☐
- (b) The set of Rational numbers ☐
- (c) The set of Real numbers ☐
- (d) The subset of a countable set ☐
23. If a and b are two different rational numbers, then either $a > b$ or $b > a$. This property is expressed by saying that the ☐
- (a) Set of rational numbers is dense or order dense ☐
- (b) Set of rational numbers is Archimedean or Archimedean ordered ☐
- (c) Order relation is total or the order relation satisfies the law of Trichotomy ☐
- (d) None of the above ☐
24. If a, b and c are any three rational numbers, then $a < b \Rightarrow a+c < b+c$. This property is expressed by saying that the ☐
- (a) Order structure of the set of rational numbers is compatible with its algebraic structure w.r.t. addition ☐
- (b) Set of rational numbers is Archimedean ☐
- (c) Set of rational numbers is dense ☐
- (d) All of the above ☐

25. Between two different rational numbers, there lie how many rational numbers?

- (a) Only one rational number ☐
 (b) More than one but only a finite number of rational numbers ☐
 (c) An infinite number of rational numbers ☐
 (d) None of the above ☐

26. Which one of the following properties is expressed by saying that the set of rational numbers is Archimedean ordered?

- (a) Between two different rational numbers, there lie an infinity of rational numbers ☐
 (b) If a, b, c be any three rational numbers, then $a < b, c > 0 \Rightarrow ac < bc$ ☐
 (c) If a and b be two positive rational numbers such that $a > b, a \neq 0$, then $\exists$ a positive integer n such that $nb > a$ ☐
 (d) None of the above ☐

Sections of Rational Numbers

If L and U be any two non-empty subsets of the set Q of rational numbers such that

- (i) $L \cup U = Q$
 (ii) $x \in L, y \in U \Rightarrow x < y$

Here $L \neq Q, U \neq Q, L \cap U = \emptyset$

U is called the complement of L in Q , and L is called the complement of U in Q in as much as U consists of rational numbers which are not members of L . Such a pair L, U of subsets of Q is called a section of rational numbers, to be denoted by (L, U) . L is called the lower class and U is called the Upper class of the section.

27. Which of the following is not possible for a section (L, U) of rational numbers?

- (a) L has no greatest member and U has no least member ☐
 (b) L has a greatest member and U has a least member ☐
 (c) L has no greatest member but U has a least member ☐
 (d) L has a greatest member but U has no least member ☐

28. If $L = \{x : x \leq 0, x > 0 \text{ and } x^2 < 2\}$
 $U = \{x : x > 0 \text{ and } x^2 > 2\}$

then

- (a) L has a greatest member and U has a least member ☐
 (b) L has a greatest member but U has no least member ☐
 (c) L has no greatest member but U has a least member ☐
 (d) L has no greatest member and U has no least member ☐

29. Which of the following statements is correct?

- (a) A pair of non-empty subsets L and U of Q is a section if ☐
 (i) $L \cup U = Q$
 (ii) $x \in L, y \in U \Rightarrow x < y$
 (iii) L has no greatest member
 (b) A pair of non-empty subsets L and U of Q is a section if ☐
 (i) $L \cup U = Q$
 (ii) $x \in L, y \in U \Rightarrow x < y$
 (iii) U has no smallest member

(c) Any given non-empty subset L of Q will form the lower class of a section if it is such that ☐

- (i) $L \neq Q$
 (ii) $x \in L, y < x \Rightarrow y \in L$
 (iii) L has no greatest member

(d) All of the above ☐

30. Which of the following statements is correct?

- (a) A section of rational numbers is called a real number. ☐
 (b) A section is said to be a real rational if the upper class of the section does not have a smallest member ☐

(c) A section is said to be a real irrational if the upper class of the section has a smallest member ☐

(d) All of the above ☐

31. Which of following statements is correct?

- (a) The set of all rational numbers is the subset of the set of all real rational numbers ☐

(b) The set of all real rational numbers is the subset of the set of all rational numbers ☐

(c) The set of all rational numbers is equivalent to the set of all real rational numbers ☐

(d) None of the above ☐

32. A real number $\alpha_1 = (L_1, U_1)$ is smaller than the real number $\alpha_2 = (L_2, U_2)$ if

(a) L_1 is a proper part of L_2 ☐

(b) L_1 is a proper part of U_1 ☐

(c) L_2 is a proper part of L_1 ☐

(d) L_2 is a proper part of U_2 ☐

33. If L_1 is a proper part of L_2 , then $\exists$ an infinite number of members which belong to

(a) L_2 but not to U_1 ☐

(b) L_2 but not to L_1 ☐

(c) L_1 but not to L_2 ☐

(d) U_1 but not to L_2 ☐

34. If L_1 is a proper part of L_2 , then $\exists$ an infinite number of members which belong to

(a) U_1 ☐

(b) U_2 ☐

(c) L_2 and L_1 both ☐

(d) None of the above ☐

35. A real number (L, U) is positive if

(a) L and U both contain an infinite number of positive members ☐

(b) L contains an infinite number of positive members ☐

(c) U contains an infinite number of positive members ☐

(d) Any one of the above holds ☐

36. A real number (L, U) is negative if

(a) L and U both contain an infinite number of negative members ☐

(b) L contains an infinite number of negative members ☐

(c) U contains an infinite number of negative members ☐

(d) Any one of the above holds ☐

37. If α, β and γ be any three elements of R (the set of all real numbers) then R is totally ordered if

(a) Either $\alpha < \beta$ or $\beta < \alpha$ ☐

(b) $\alpha < \beta, \beta < \gamma \Rightarrow \alpha < \gamma$ ☐

(c) Both of the above hold ☐

(d) None of the above holds ☐

38. Which of the following statements is correct?

Let a^* and b^* be real rational numbers corresponding to rational numbers a and b respectively, then

(a) If $\alpha = (L, U)$,

$a \in L \Rightarrow a^* < \alpha$ ☐

(b) If $\alpha = (L, U)$

$b \in U \Rightarrow \alpha \leq b^*$ ☐

(c) $a < b \Leftrightarrow a^* < b^*$ ☐

(d) All of the above ☐

39. Which of the following statements refers to the property of order completeness of Real numbers? If L and U be two proper subsets of the set R of real numbers such that

(i) $L \cup U = R$

(ii) $\alpha \in L, \beta \in U \Rightarrow \alpha < \beta$ then

(a) L has a greatest member ☐

(b) U has a smallest member ☐

(c) Either L has a greatest member or U has a smallest member ☐

(d) Neither L has a greatest member nor U has a smallest member ☐

40. Which of the following statements is wrong

(a) The set of real numbers is order complete ☐

(b) The set of rational numbers is order complete ☐

(c) Between two real numbers, there lie infinite number of irrational numbers ☐

(d) The set of rational numbers is Archimedean ordered ☐

41. Which of the following functions is an algebraic one?

(a) 5^x ☐

(b) $\log(1+x)$ ☐

(c) $\sqrt{2x+3}$ ☐

(d) $\sin x$ ☐

42. Which of the following functions is a transcendental one?

(a) x^x ☐

(b) $\frac{(x+5)(x-9)}{2x+3}$ ☐

(c) $\sqrt{x^2+x+1}$ ☐

(d) All of the above ☐

43. Which of the following functions is an odd one ?

(a) x^4+x^2+1 ☐

(b) $\cos x$ ☐

(c) Constant function ☐

(d) x^3+x ☐

44. Which of the following is an implicit function of x and y ?

(a) $f(x, y)=1$ ☐

(b) $f(x).f(y)=0$ ☐

(c) $f(x, y)=0$ ☐

(d) $y=f(x)$ ☐

45. What is the limit of the function ?

$$\frac{x^2-4}{x-2} \text{ as } x \rightarrow 2$$

(a) 0 ☐

(b) Does not exist ☐

(c) 2 ☐

(d) 4 ☐

46. Find the limit of the function

$$(x-a) \cos \left[\frac{1}{x-a} \right] \text{ as } x \rightarrow a ?$$

(a) 0 ☐

(b) a ☐

(c) $\cos a$ ☐

(d) Does not exist ☐47. What is $\lim_{x \rightarrow 0} \sin \frac{1}{x}$?

(a) 0 ☐

(b) 1 ☐

(c) ∞ ☐

(d) Does not exist ☐48. What is $\lim_{x \rightarrow 0} \frac{\sin x}{x}$?

(a) 0 ☐

(b) 1 ☐

(c) $\pi/2$ ☐

(d) None of the above ☐49. $\lim_{x \rightarrow \infty} \left(1 + \frac{1}{x} \right)^x$ is equal to

(a) 0 ☐

(b) e ☐

(c) e^2 ☐

(d) None of the above ☐50. $\lim_{x \rightarrow 0} (1+x)^{\frac{1}{x}}$ is equal to

(a) 1 ☐

(b) ∞ ☐

(c) e ☐

(d) e^2 ☐

51. What is $\lim_{x \rightarrow 0} \frac{e^x-1}{x}$?

(a) -1 ☐

(b) 1 ☐

(c) 0 ☐

(d) Does not exist ☐

52. Find the limit of the function

$$\frac{a^x-1}{x} \text{ as } x \rightarrow 0$$

(a) 0 ☐

(b) $\log a$ ☐

(c) e^a ☐

(d) None of the above ☐53. Find the limit of $\frac{x^n-a^n}{x-a}$ as $x \rightarrow a$ ($a > 0$)

(a) 0 ☐

(b) $\log a$ ☐

(c) na ☐

(d) na^{n-1} ☐

54. The limit of the function

$$x \sin \frac{1}{x}, \text{ as } x \rightarrow 0, \text{ is}$$

(a) 0 ☐

(b) ∞ ☐

(c) Does not exist ☐(d) None of the above ☐

55. Which of the following limits exist?

(a) $\lim_{x \rightarrow 0} \frac{1}{x^2}$ ☐

(b) $\lim_{x \rightarrow 0} \frac{1}{x}$ ☐

(c) $\lim_{x \rightarrow \pi/2} \tan x$

(d) $\lim_{x \rightarrow 0} 2^{1/x}$

56. $\lim_{x \rightarrow 0} 2^{-1/x^2}$ is

(a) 2

(b) $\frac{1}{2}$

(c) ∞

(d) None of the above

57. If $f(x)=[x]$, where $[x]$ is the greatest integer not greater than x , then

$\lim_{x \rightarrow 1} f(x)$ is

(a) 0

(b) 1

(c) Does not exist

(d) None of the above

58. The right handed limit of $\log x$ as $x \rightarrow 0$

is

(a) 0

(b) ∞

(c) $-\infty$

(d) 1

59. $\lim_{x \rightarrow 0} \frac{e^{1/x}}{x}$ as $x \rightarrow 0$ is

(a) 0

(b) ∞

(c) does not exist

(d) e

60. The right handed limit of the function $\frac{|x|}{x}$ as $x \rightarrow 0$ is

(a) 1

(b) -1

(c) 0

(d) ∞

61. The left handed limit of the function

$\frac{|x|}{x}$ as $x \rightarrow 0$ is

(a) 1

(b) -1

(c) 0

(d) ∞

62. If $f(x) = \frac{x-1}{x}$ for all real numbers except $x=0$ and $g(u) = u^2 + 1$ for all real numbers u , then $f[g(u)]$ is not defined for

(a) All real numbers u

(b) $u = -1$

(c) $u^2 = -1$

(d) $u = 0$

63. Let $f(x)=1$ if x is a rational number and $f(x)=0$ if x is an irrational number, be a function from R into R , then $f \circ f(1.4327)$ is equal to

(a) 1

(b) 0

(c) Indeterminate

(d) None of the above.

64. $\lim_{x \rightarrow 1} 2^{\frac{1}{x-1}}$ is

(a) ∞

(b) 0

(c) 1

(d) Does not exist.

65. Which of the following limits do not exist?

(a) $\lim_{x \rightarrow 0} \frac{1}{1-e^{\frac{1}{x}}}$

(b) $\lim_{x \rightarrow a} \frac{1}{1-e^{\frac{1}{x-a}}}$

(c) $\lim_{x \rightarrow 0} e^{\frac{1}{x}}$

(d) All of the above.

66. $\lim_{n \rightarrow \infty} x^n = 0$ for

(a) $x=1$

(b) $x > 1$

(c) $x < -1$

(d) $|x| < 1$

67. The limit of $\frac{x^n}{n}$, where $n \rightarrow \infty$ through positive integral values, is given by

(a) 0

(b) $\frac{1}{n}$

(c) ∞

(d) None of the above.

68. For every value of n , $\left(1 + \frac{1}{n}\right)^n$ lies between

(a) 1 and 2

- (b) 2 and 2.5 ☐
 (c) 2 and 3 ☐
 (d) 3 and 3.5 ☐

69. $\lim_{x \rightarrow 0} \left(1 + \frac{x}{a}\right)^{\frac{1}{x}}$ is

- (a) e^a ☐
 (b) $e^{\frac{1}{a}}$ ☐
 (c) $\log a$ ☐
 (d) $\log \frac{1}{a}$ ☐

70. A function $f(x)$ is continuous at $x=a$

if

- (a) Both the left handed and right handed limits exist as $x \rightarrow a$ and are equal ☐
 (b) Either the left handed or the right handed limit exist as $x \rightarrow a$ and is equal to value of the function at $x=a$ ☐
 (c) Both the left handed and right handed limits exist as $x \rightarrow a$ and are equal to the value of the function at $x=a$ ☐
 (d) None of the above. ☐

71. Which of the following functions is not continuous at $x=0$?

- (a) $f(x) = x^2 \sin \frac{1}{x} \quad (x \neq 0)$
 $f(0)=0$ ☐
 (b) $f(x) = x \sin \frac{1}{x} \quad (x \neq 0)$
 $f(0)=0$ ☐
 (c) $f(x) = \cos \frac{1}{x} \quad (x \neq 0)$
 $f(0)=0$ ☐
 (d) $f(x) = x \frac{1-e^{\frac{1}{x}}}{1+e^{\frac{1}{x}}}, \quad (x \neq 0)$
 $f(0)=0$ ☐

72. Which of the following functions is continuous at $x=0$?

(a) $f(x) = \frac{\frac{1}{e^x}}{1+e^x} \quad (x \neq 0)$

$f(0)=0$ ☐

(b) $f(x) = \frac{\frac{1}{e^x} - 1}{e^{\frac{1}{x}} + 1} \quad (x \neq 0)$

$f(0)=0$ ☐

(c) $f(x) = 1 \quad (x \leq 0)$
 $= x + \frac{1}{2} \quad (x > 0)$ ☐

(d) $f(x) = \frac{1-e^{\frac{1}{x}}}{1+e^{\frac{1}{x}}} \quad (x \neq 0)$

$f(0)=0$ ☐

73. $\lim_{x \rightarrow 0} \frac{3x+4 \tan x}{x}$ is

- (a) 3 ☐
 (b) 4 ☐
 (c) 7 ☐
 (d) 0 ☐

74. If both the left as well as right handed limits exist as $x \rightarrow a$ and are not equal, then the function is said to have

- (a) A Discontinuity of the first kind at $x=a$ ☐
 (b) A Discontinuity of the second kind at $x=a$ ☐
 (c) Mixed discontinuity at $x=a$ ☐
 (d) Removable discontinuity. ☐

75. The function defined by

$f(x) = (1+3x)^{\frac{1}{x}} \quad (x \neq 0)$
 $f(0)=0$

- (a) Has a discontinuity of the first kind at $x=0$ ☐
 (b) Has a discontinuity of the second kind at $x=0$ ☐
 (c) Has removable discontinuity at $x=0$ ☐
 (d) Is continuous for $x=0$. ☐

76. The function defined by

$$f(x) = \frac{x-1}{1+e^{\frac{1}{x-1}}} \quad (x \neq 1)$$

$$f(1)=0$$

- (a) Is continuous for $x=1$ ☐
 (b) Has a discontinuity of the first kind at $x=1$ ☐
 (c) Has mixed discontinuity at $x=1$ ☐
 (d) Has removable discontinuity at $x=1$. ☐

77. $\lim_{n \rightarrow \infty} \left[\frac{1}{n^2} + \frac{2}{n^2} + \dots + \frac{1}{n} \right]$ is

- (a) 0 ☐
 (b) $\frac{1}{2}$ ☐
 (c) 1 ☐
 (d) ∞ ☐

78. $\lim_{n \rightarrow \infty} \left[\frac{1}{n^3} + \frac{4}{n^3} + \frac{9}{n^3} + \dots + \frac{1}{n} \right]$ is

- (a) 0 ☐
 (b) $\frac{1}{3}$ ☐
 (c) $\frac{1}{2}$ ☐
 (d) None of the above. ☐

79. $\lim_{h \rightarrow 0} \frac{\sin(x+h) - \sin x}{h}$ is

- (a) $\sin x$ ☐
 (b) $-\sin x$ ☐
 (c) $\cos x$ ☐
 (d) Does not exist. ☐

80. Which of the following functions is continuous at $x=0$?

(a) $f(x) = \frac{\sin 2x}{x} \quad (x \neq 0)$ ☐
 $f(0)=1$

(b) $f(x) = (1+x)^{\frac{1}{x}} \quad (x \neq 0)$ ☐
 $f(0)=1$

(c) $f(x) = \frac{\sin x}{x} \quad (x \neq 0)$ ☐
 $f(0)=1$

(d) $f(x) = e^{\frac{-1}{x^2}} \quad (x \neq 0)$ ☐
 $f(0)=1$.

81. Which of the following functions is discontinuous at $x=0$?

(a) $f(x) = \frac{e^{\frac{-1}{x}}}{1+e^{\frac{1}{x}}} \quad (x \neq 0)$ ☐
 $f(0)=1$

(b) $f(x) = \frac{e^{\frac{1}{x^2}}}{e^{\frac{1}{x^2}} - 1} \quad (x \neq 0)$ ☐
 $f(0)=1$

(c) $f(x) = (1+2x)^{\frac{1}{x}} \quad (x \neq 0)$ ☐
 $f(0)=e^2$

(d) $f(x) = \frac{\tan 2x}{3x} \quad (x \neq 0)$ ☐
 $f(0) = \frac{2}{3}$

82. $\lim_{x \rightarrow \infty} \sinh x$ is equal to

- (a) ∞ ☐
 (b) $-\infty$ ☐
 (c) 1 ☐
 (d) -1 ☐

83. $\lim_{x \rightarrow \infty} \cosh x$ is equal to

- (a) ∞ ☐
 (b) $-\infty$ ☐
 (c) 1 ☐
 (d) -1 ☐

84. $\lim_{x \rightarrow \infty} \tanh x$ is equal to

- (a) ∞ ☐
 (b) $-\infty$ ☐
 (c) 1 ☐
 (d) -1 ☐

85. The function defined by

$$f(x) = \cos x \quad (x \geq 0)$$

$$= -\cos x \quad (x < 0)$$

- (a) Has a discontinuity of the first kind at $x=0$ ☐
- (b) Has a discontinuity of the second kind at $x=0$ ☐
- (c) Has a removable discontinuity at $x=0$ ☐
- (d) Is continuous at $x=0$. ☐
86. The function defined by

$$f(x) = 1+x \quad (x \leq 2)$$

$$= 5-x \quad (x > 2)$$
- (a) Is continuous at $x=2$ ☐
- (b) Has a discontinuity of the first kind at $x=2$ ☐
- (c) Has a discontinuity of the second kind at $x=2$ ☐
- (d) Has a removable discontinuity at $x=2$. ☐
87. A function $f(x)$ is said to be differentiable at $x=a$ if
- (a) It is continuous ☐
- (b) $\lim_{h \rightarrow 0} \frac{f(a+h)-f(a)}{h}$ exists and is equal to value of the function at $x=a$ ☐
- (c) $\lim_{h \rightarrow 0} \frac{f(a-h)-f(a)}{-h}$ exists and is equal to value of the function at $x=a$ ☐
- (d) $\lim_{h \rightarrow 0} \frac{f(a+h)-f(a)}{h}$ and $\lim_{h \rightarrow 0} \frac{f(a-h)-f(a)}{-h}$ both exist and are equal. ☐
88. If a function $f(x)$ is differentiable at $x=a$, then
- (a) It is continuous at $x=a$ ☐
- (b) $\lim_{h \rightarrow 0} \frac{f(a+h)-f(a)}{h}$ and $\lim_{h \rightarrow 0} \frac{f(a-h)-f(a)}{-h}$ both exist and are equal ☐
- (c) $\lim_{h \rightarrow 0} f(a+h) = \lim_{h \rightarrow 0} f(a-h)$ ☐
- (d) all of the above hold. ☐
89. The function defined by

$$f(x) = \sin x \frac{1}{x} \quad (x \neq 0)$$

$$f(0)=0, \text{ is}$$
- (a) Differentiable but not continuous ☐
- (b) Continuous but not differentiable ☐
- (c) Both continuous and differentiable ☐
- (d) Neither continuous nor differentiable. ☐
90. The function defined by

$$f(x) = x^2 \sin \frac{1}{x} \quad (x \neq 0)$$

$$f(0)=0, \text{ is}$$
- (a) Continuous but not differentiable at $x=0$ ☐
- (b) Neither continuous nor differentiable at $x=0$ ☐
- (c) Differentiable at $x=0$ ☐
- (d) None of the above. ☐
91. The function $f(x) = |x|$ is
- (a) Continuous at $x=0$ ☐
- (b) Not continuous at $x=0$ ☐
- (c) Differentiable at $x=0$ ☐
- (d) None of the above. ☐
92. Which of the following functions is differentiable?
- (a) $f(x) = e^{-\frac{1}{x^2}} \sin \frac{1}{x} \quad (x \neq 0)$
 $f(0)=0, \text{ at } x=0$ ☐
- (b) $\phi(x) = 1+x \quad \text{if } x \leq 2$
 $= 5-x \quad \text{if } x > 2, \text{ at } x=2$ ☐
- (c) $f(x) = 1 \quad (x < 1)$
 $= \frac{1}{x} \quad (x > 1)$
 $f(1)=2, \text{ at } x=1$ ☐
- (d) None of the above. ☐
93. The function

$$f(x) = |x-1| + |x-2| \text{ is differentiable in } [0, 3] \text{ except at}$$
- (a) $x=0$ and $x=3$ ☐
- (b) $x=1$ ☐
- (c) $x=2$ ☐

(d) $x=1$ and $x=2$ ☐

94. Consider the function defined by

$$f(x) = x^p \cos \frac{1}{x} \quad (x \neq 0)$$

$$f(0) = 0$$

In order that $f(x)$ be differentiable at $x=0$, what condition is expected to be satisfied by p ?

(a) $p > 0$ ☐

(b) $p > 0$ but $p < 1$ ☐

(c) $p < 0$ ☐

(d) $p > 1$ ☐

95. Which of the following is not a property of continuous functions?

(a) If $f(x)$ be continuous for $x=c$ and $f(c) \neq 0$. Then there exists an interval $(c-\delta, c+\delta)$ around c such that $f(x)$ has the same sign as $f(c)$ for all values of x in this interval ☐

(b) If $f(x)$ be continuous in a closed interval $[a, b]$. Then there exist points c and d in $[a, b]$, where $f(x)$ assumes its greatest value M and the least value m respectively ☐

(c) If $f(x)$ be continuous in a closed interval $[a, b]$ and let $f(a)$ and $f(b)$ have opposite signs. Then $f(x)$ is positive for all values of x lying between a and b ☐

(d) In (c), $f(x)=0$ for atleast one value of x , lying between a and b ☐

96. If a function $f(x)$ is derivable in the closed interval $[a, b]$, and $f(a)=f(b)$, then $\exists$ atleast one value of x lying within $[a, b]$ such that $f'(x)=0$. This is known as

(a) Lagrange's mean value theorem ☐

(b) Cauchy's mean value theorem ☐

(c) Maclaurin's theorem ☐

(d) Rolle's theorem ☐

97. If a curve has a tangent at each of its points and the ordinates of its extremities are equal, then there exists atleast one point of the curve other than its extremities, the tangent at which is parallel to x -axis. This is known as

(a) Rolle's theorem ☐

(b) Lagrange's mean value theorem ☐

(c) Cauchy's mean value theorem ☐

(d) None of the above ☐

98. Consider the function

$$f(x) = x(x+3)e^{-x/2}$$

How many values of x exist in $[-3, 0]$ for which $f'(x)$ vanishes?

(a) None ☐

(b) One ☐

(c) Two ☐

(d) Three ☐

99. For Rolle's theorem to be satisfied for any function $f(x)$ in $[a, b]$, how many values can x take in $[a, b]$ for which $f'(x)$ vanishes?

(a) Only one ☐

(b) Only two ☐

(c) Any number of values ☐

(d) Atleast one ☐

100. Which one of the following is the statement of Lagrange's mean value theorem.

(a) If a function $f(x)$ and $F(x)$ are derivable in an interval $[a, b]$ and $F(x) \neq 0$ for any value of x in $[a, b]$, then there exists at least one value c of x lying within $[a, b]$ such that ☐

$$\frac{f(b)-f(a)}{F(b)-F(a)} = \frac{f'(c)}{F'(c)}$$

(b) If a function $f(x)$ is derivable in an interval $[a, a+h]$, $\exists$ at least one number θ lying between 0 and 1 such that

$$f(a+h) = f(a) + hf'(a+\theta h)$$

(c) If a function $f(x)$ possesses derivatives $f'(x), f''(x), \dots, f^{(n)}(x)$ upto a certain order n for every value of x in the interval $[a, a+h]$ then $\exists$ atleast one number θ lying between 0 and 1 such that

$$f(a+h) = f(a) + hf'(a) + \frac{h^2}{2!} f''(a) + \dots + \frac{h^{n-1}}{(n-1)!} f^{(n-1)}(a) + \frac{h^n}{n!} f^{(n)}(a+\theta h)$$

(d) None of (a), (b) and (c) is the statement of Lagrange's mean value theorem ☐

101. If two functions $f(x)$ and $F(x)$ are derivable in an interval $[a, a+h]$ and $F'(x) \neq 0$ then $\exists$ atleast one number θ lying between 0 and 1 such that

$$\frac{f(a+h)-f(a)}{F(a+h)-F(a)} = \frac{f'(a+\theta h)}{F'(a+\theta h)}$$

This is

- (a) Lagrange's mean value theorem ☐
 (b) Cauchy's mean value theorem ☐
 (c) Taylor's development of a function with Lagrange's form of remainder ☐
 (d) Taylor's development of a function with Cauchy's form of remainder. ☐

If a function $f(x)$ is derivable in the interval $[a, b]$, then $\exists$ atleast one value c of x lying within $[a, b]$ such that

$$\frac{f(b)-f(a)}{b-a} = f'(c)$$

102. Which of the following interpretations about $f(b)-f(a)$ is correct?

- (a) It is the average rate of change of the function $f(x)$ over $[a, b]$ ☐
 (b) It is actual rate of change of the function for $x=c$ ☐
 (c) It is the change in the function $f(x)$ as x changes from a to b ☐
 (d) None of the above ☐

103. $\frac{f(b)-f(a)}{b-a}$ is the

- (a) Average rate of change of the function $f(x)$ over $[a, b]$ ☐
 (b) Actual rate of change of the function $f(x)$ for $x=c$ ☐
 (c) Change in the function $f(x)$ as x changes from a to b ☐
 (d) None of the above ☐

104. $f'(c)$ is the

- (a) Average rate of change of the function $f(x)$ over $[a, b]$ ☐
 (b) Actual rate of change of the function for $x=c$ ☐
 (c) Change in the function $f(x)$ for $x=c$ ☐
 (d) None of the above ☐

105. A function $f(x)$ is called monotonically increasing function of x in $[a, b]$, if

- (a) $f'(x) < 0$ for every value of x in $[a, b]$ ☐
 (b) $f(x) < 0$ for every value of x in $[a, b]$ ☐
 (c) $f'(x) > 0$ for every value of x in $[a, b]$ ☐
 (d) $f(x) > 0$ for every value of x in $[a, b]$ ☐

106. The function

$$f(x) = 2x^3 - 15x^2 + 36x + 1$$

is monotonically decreasing in

- (a) $(-\infty, 2]$ ☐
 (b) $[2, 3]$ ☐
 (c) $[3, \infty)$ ☐
 (d) None of the above ☐

107. If a function $f(x)$ is derivable in $[a, b]$ then $\exists$ atleast one value c of x such that

- (a) $\frac{f(b)-f(a)}{a-b} = f'(c), a < c < b$ ☐
 (b) $\frac{f(b)-f(a)}{b-a} = f'(c), a > c > b$ ☐
 (c) $\frac{f(b)-f(a)}{b-a} = f'(c), a < c < b$ ☐
 (d) $\frac{f(b)-f(a)}{a-b} = f'(c), a > c > b$ ☐

108. If in the Cauchy's mean value theorem, we put $f(x) = \sin x$ and $F(x) = \cos x$ then c is

- (a) A.M. of a and b ☐
 (b) $\frac{\sin x + \cos x}{2}$ ☐
 (c) $\sin 2x$ ☐
 (d) $\sqrt{\sin x \cos x}$ ☐

109. In Taylor's theorem with Lagrange's form of remainder, the remainder after n terms is given by

- (a) $\frac{h^{n-1}}{n-1} f^n(a+\theta h)$ ☐
 (b) $\frac{h^n}{n} f^n(a+\theta h)$ ☐
 (c) $\frac{h^n}{n-1} f^{n-1}(a+\theta h)$ ☐

$$(d) \frac{h^{n-1}}{n} f^{n-1}(a+\theta h)$$

□

110. In Taylor's theorem with Cauchy's form of remainder, the remainder after n terms is

$$(a) \frac{h^n}{n-1} f^n(a+\theta h)$$

□

$$(b) \frac{h^{n-1}}{n} f^n(a+\theta h)$$

□

$$(c) \frac{h^{n-1}}{n} (1-\theta)^{n-1} f^n(a+\theta h)$$

□

$$(d) \frac{h^n}{n-1} (1-\theta)^{n-1} f^n(a+\theta h)$$

□

111. Maclaurin's development of $f(x)$ in $[0, x]$ in the finite form with Lagrange's form of remainder is given by

$$(a) f(x) = f(0) + x f'(0) + \frac{x^2}{2} f''(0) + \dots + \frac{x^{n-1}}{n-1} f^{n-1}(0)$$

$$+ \frac{x^n}{n-1} (1-\theta)^{n-1} f^n(\theta x)$$

□

$$(b) f(x) = f(0) + x f'(0) + \frac{x^2}{2} f''(0)$$

$$+ \dots + \frac{x^{n-1}}{n-1} f^{n-1}(0)$$

$$+ \frac{x^n}{n} f^n(\theta x)$$

□

$$(c) f(a+h) = f(a) + hf'(a) + \frac{h^2}{2} f''(a)$$

$$+ \frac{h^3}{3} f'''(a) + \dots + \frac{h^{n-1}}{n-1} f^{n-1}(a)$$

$$+ \frac{h^n}{n} f^n(a+\theta h)$$

□

$$(d) f(a+h) = f(a) + hf'(a) + \frac{h^2}{2} f''(a)$$

$$+ \dots + \frac{h^{n-1}}{n-1} f^{n-1}(a)$$

$$+ \frac{h^n}{n-1} (1-\theta)^{n-1} f^n(a+\theta h)$$

□

$$112. 1+x+\frac{x^2}{2}+\frac{x^3}{3}+\dots+\frac{x^{n-1}}{n-1}$$

$+\frac{x^n}{n} e^{\theta x}$ is equal to

$$(a) \log x$$

□

$$(b) e^x$$

□

$$(c) e^{-x}$$

□

$$(d) \log(1-x)$$

□

$$113. 1 - \frac{x^2}{2} + \frac{x^4}{4} - \dots + (-1)^n \frac{x^{2n}}{2n}$$

$$+ (-1)^{n+1} \frac{x^{2n+1}}{2n+1} \sin \theta x$$

is equal to

$$(a) \sin x$$

□

$$(b) \cos x$$

□

$$(c) \tan x$$

□

$$(d) \log x$$

□

$$114. \lim_{h \rightarrow 0} \frac{f(x+h) - 2f(x) + f(x-h)}{h^2}$$

is equal to

$$(a) \frac{f''(x)}{h}$$

□

$$(b) f''(x)$$

□

$$(c) \text{Does not exist}$$

□

$$(d) 2f''(x)$$

□

115. If, under certain conditions,

$$f(a+\theta h) = f(a) + hf'(a+\theta h) \quad (0 < \theta < 1)$$

provided $f''(a)$ is continuous and non zero, then as $h \rightarrow 0$, $\theta \rightarrow$

$$(a) 0$$

□

$$(b) 1$$

□

$$(c) \frac{1}{2}$$

□

$$(d) 1/3$$

□

116. $f(c)$ is said to be the maximum value of the function $f(x)$ if $\exists$ some interval $(c-\delta, c+\delta)$ around c such that for all values of x , other than c , lying in this interval

$$(a) f(c) < f(x)$$

□

$$(b) f(c-\delta) > f(c)$$

□

$$(c) f(c+\delta) > f(c)$$

□

$$(d) f(c) > f(x)$$

□

117. Mark the correct statement :

$$(a) f(c) \text{ is an extreme value of } f(x) \text{ iff } f'(c) = 0$$

□

- (b) If $f(c)$ is an extreme value of $f(x)$, then $f'(c)=0$ ☐
- (c) If $f'(c)=0$, then $f(c)$ is an extreme value of $f(x)$ ☐
- (d) All of the above statements are incorrect ☐

118. The greatest and least values of $f(x)$ in any interval $[a, b]$ are given by

- (a) $f(a)$ and $f(b)$ ☐
- (b) The values of x for which $f'(x)=0$ ☐
- (c) Either (a) or (b) ☐
- (d) None of the above ☐

119. The greatest and least values of $3x^4-2x^3-6x^2+6x+1$ in $[0, 2]$ are

- (a) 2 and 1 ☐
- (b) 21 and 2 ☐
- (c) $\frac{39}{16}$ and 1 ☐
- (d) 21 and 1 ☐

120. $f(c)$ is a maximum value of $f(x)$ when

- (a) $f'(x)$ changes sign from positive to negative as x passes through 0 ☐
- (b) $f'(x)$ changes sign from negative to positive as x passes through 0 ☐
- (c) $f'(x)$ does not change sign as x passes through 0. ☐
- (d) $f'(x)$ changes sign from positive to negative as x passes through c ☐

121. $f(c)$ is neither maximum nor minimum value of $f(x)$ if

- (a) The tangent to the curve on either side of the point $x=c$ makes an acute angle or obtuse angle ☐
- (b) The tangent to the curve at every point in left-handed neighbourhood of the point $x=c$ whose ordinate is maximum, makes an acute angle and in a right-handed neighbourhood of the point $x=c$ makes an obtuse angle ☐
- (c) The tangent to the curve at every point in a left-handed neighbourhood of the point $x=c$ whose ordinate is minimum, makes an obtuse angle and in a right-handed neighbourhood of the point $x=c$ makes an acute angle ☐
- (d) The tangent to the curve at every point in a left-handed neighbour-

hood of the point $x=c$, whose ordinate is minimum, makes an acute angle and in a right-handed neighbourhood of the point $x=c$ makes an obtuse angle ☐

122. If $f'(c)$ changes sign from negative to positive as x passes through c , then

- (a) $f(c)$ is neither maximum nor minimum value of $f(x)$ ☐
- (b) $f(c)$ is the maximum value of $f(x)$ ☐
- (c) $f(c)$ is the minimum value of $f(x)$ ☐
- (d) $f(c)$ is either maximum or minimum value of $f(x)$ ☐

123. The polynomial

$$x^4-8x^3+22x^2-24x+1$$

has a maximum value at

- (a) $x=1$ ☐
- (b) $x=2$ ☐
- (c) $x=3$ ☐
- (d) None of the above ☐

124. $f(c)$ is a maximum value of $f(x)$ if

- (a) $f''(c)=0, f'''(c)\neq 0$ ☐
- (b) $f'(c)=0, f''(c)>0$ ☐
- (c) $f'(c)=0, f''(c)<0$ ☐
- (d) $f'(c)\neq 0, f''(c)=0$ ☐

125. $f(c)$ is a minimum value of $f(x)$ if

- (a) $f''(c)=0, f'''(c)\neq 0$ ☐
- (b) $f'(c)\neq 0, f''(c)=0$ ☐
- (c) $f'(c)=0, f''(c)>0$ ☐
- (d) $f'(c)=0, f''(c)<0$ ☐

126. If $f'(c)=f''(c)=\dots=f^{n-1}(c)=0$, $f^n(c)\neq 0$ and n is even, then

- (a) $f(c)$ is neither maximum nor minimum value of $f(x)$ ☐
- (b) $f(c)$ is a maximum value of $f(x)$ if $f^n(c)<0$ ☐
- (c) $f(c)$ is a minimum value of $f(x)$ if $f^n(c)<0$ ☐
- (d) $f(c)$ is a maximum value of $f(x)$ if $f^n(c)>0$ ☐

127. A circle of radius unity is inscribed in an isosceles triangle. The least perimeter of such a triangle is

- (a) $3\sqrt{3}$ ☐
- (b) 9 ☐
- (c) $6\sqrt{3}$ ☐

(d) None of the above ☐128. $f(a, b)$ is the maximum value of $f(x, y)$ if ☐(a) $*A*C - *B^2 < 0$ ☐(b) $AC - B^2 > 0$ ☐(c) $AC - B^2 > 0$ but $A < 0$ ☐(d) $AC - B^2 > 0$ and $A > 0$ ☐

$$*A = \left(\frac{\partial^2 f}{\partial x^2} \right)_{\substack{x=a \\ y=b}}$$

$$*B = \left(\frac{\partial^2 f}{\partial x \partial y} \right)_{\substack{x=a \\ y=b}}$$

$$= \left(\frac{\partial^2 f}{\partial y \partial x} \right)_{\substack{x=a \\ y=b}}$$

$$*C = \left(\frac{\partial^2 f}{\partial y^2} \right)_{\substack{x=a \\ y=b}}$$

129. The equation of the tangent at any point (x, y) on the curve $y=f(x)$ is given by ☐(a) $(X-x)=f'(x)(Y-y)$ ☐(b) $(Y-y)=f'(x)(X-x)$ ☐(c) $(Y-y)+f'(x)(X-x)=0$ ☐(d) $(X-x)+f'(x)(Y-y)=0$ ☐130. The equation of the normal to the curve $y=f(x)$ at any point (x, y) is given by ☐(a) $(X-x)=f'(x)(Y-y)$ ☐(b) $(X-x)=-f'(x)(Y-y)$ ☐(c) $(X-x)f'(x)=Y-y$ ☐(d) $-(X-x)f'(x)=Y-y$ ☐131. The slope of the normal to the curve $y=f(x)$ at any point (x, y) is given by ☐(a) $\frac{y}{x}$ ☐(b) $\frac{Y-y}{X-x}$ ☐(c) $-\frac{y}{x}$ ☐(d) $\frac{x-X}{Y-y}$ ☐132. What is the slope of the normal to the cycloid $x=a(\theta \sin \theta)$, $y=a(1-\cos \theta)$ at $\theta=\pi/2$? ☐(a) 1 ☐(b) -1 ☐(c) Does not exist ☐(d) None of the above ☐133. The tangents to a given algebraic curve at the origin are obtained by equating to zero the ☐(a) Highest degree terms ☐(b) Lowest degree terms ☐(c) First degree terms ☐(d) Terms of any degree ☐134. How many tangents are there at the origin to the curve $x^4+y^4+x^2-y^2=0$ ☐(a) 1 ☐(b) 2 ☐(c) 4 ☐(d) None of the above ☐135. The angle of intersection of two curves at a point of intersection is the angle between the ☐(a) Tangents to the two curves at that point ☐(b) Normals to the two curves at that point ☐(c) Tangent to the first curve and normal to the second curve at that point ☐(d) Tangent to the second curve and normal to the first curve at that point ☐136. Length of the tangent at any point (x, y) of the given curve $y=f(x)$ is ☐(a) $\frac{y\sqrt{1+y_1^2}}{y_1}$ (where $y_1 = \frac{dy}{dx}$) ☐(b) $y\sqrt{1+y_1^2}$ ☐(c) $\frac{y_1}{y} \sqrt{1+y_1^2}$ ☐(d) $y_1 \sqrt{1+y_1^2}$ ☐137. Length of subtangent at any point (x, y) of the given curve $y=f(x)$ is ☐(a) yy_1 ☐(b) $\frac{y_1}{y}$ ☐(c) $\frac{y}{y_1}$ ☐

(d) None of the above ☐

138. The length of the normal and the sub-normal of the given curve at any point (x, y) are respectively

(a) $\frac{y}{y_1} \sqrt{1+y_1^2}$ and $\frac{y}{y_1}$ ☐

(b) $\frac{y}{y_1} \sqrt{1+y_1^2}$ and $y\sqrt{1+y_1^2}$ ☐

(c) $y\sqrt{1+y_1^2}$ and $\frac{y}{y_1}$ ☐

(d) $y\sqrt{1+y_1^2}$ and yy_1 ☐

139. Let $y=f(x)$ ☐
be the equation of the given curve. ☐

Let $p = \frac{y - x f'(x)}{\sqrt{1 + [f'(x)]^2}}$ ☐

and $r^2 = x^2 + y^2$ ☐

where p is the length of the perpendicular from the origin on the tangent at any point (x, y) on (1) and r is the distance between $(0, 0)$ and (x, y) . Then pedal equation of the curve (1) is obtained by eliminating x and y from equations

(a) (1) and (2) ☐

(b) (1) and (3) ☐

(c) (2) and (3) ☐

(d) (1), (2) and (3) ☐

140. The angle ϕ between the radius vector r and tangent at any point (r, θ) on the given curve $r=f(\theta)$, is given by

(a) $\cot \phi = r \frac{d\theta}{dr}$ ☐

(b) $\cot \phi = r \frac{dr}{d\theta}$ ☐

(c) $\cot \phi = \frac{1}{r} \frac{dr}{d\theta}$ ☐

(d) $\tan \phi = r \frac{dr}{d\theta}$ ☐

141. The angle of intersection of the cardioids

$r=a(1+\cos \theta)$ and $r=b(1-\cos \theta)$ is

(a) $\frac{\pi}{4}$ ☐

(b) $\frac{\pi}{2}$ ☐

(c) $\frac{2\pi}{3}$ ☐

(d) None of the above ☐

142. Length of the perpendicular from the pole to the tangent at any point on the curve $r=f(\theta)$ is given by

(a) $r \cos \phi$ ☐

(b) $r \tan \phi$ ☐

(c) $r \sin \phi$ ☐

(d) $r \operatorname{cosec} \phi$ ☐

143. Length of the perpendicular from the pole on the tangent at any point on the curve $r=f(\theta)$ in terms of polar coordinates is given by

(a) $\frac{1}{p^2} = \frac{1}{r^2} + \frac{1}{r^2} \left(\frac{dr}{d\theta} \right)^2$ ☐

(b) $\frac{1}{p^2} = \frac{1}{r^4} + \frac{1}{r^2} \left(\frac{dr}{d\theta} \right)^2$ ☐

(c) $\frac{1}{p^2} = \frac{1}{r^2} + \frac{1}{r^4} \left(\frac{d\theta}{dr} \right)^2$ ☐

(d) None of the above ☐

144. Length of the polar sub-tangent at any point on the curve $r=f(\theta)$ is given by

(a) $r \frac{d\theta}{dr}$ ☐

(b) $\frac{d\theta}{du} \left(u = \frac{1}{r} \right)$ ☐

(c) $-\frac{d\theta}{du} \left(u = \frac{1}{r} \right)$ ☐

(d) $-r^2 \frac{d\theta}{dr}$ ☐

145. Length of the polar subnormal at any point on the curve $r=f(\theta)$ is given by

(a) $\frac{d\theta}{dr}$ ☐

(b) $-\frac{1}{u^2} \frac{du}{d\theta} \left(u = \frac{1}{r} \right)$ ☐

(c) $u^2 \frac{du}{d\theta}$ ☐

(d) $\frac{d^2r}{d\theta^2}$ ☐

146. Length of the polar tangent at any point on the curve $r=f(\theta)$ is given by

- (a) $\sqrt{1+\tan^2 \phi}$ ☐
 (b) $\sqrt{1+\cot^2 \phi}$ ☐
 (c) $\sqrt{r^2+\left(\frac{dr}{d\theta}\right)^2}$ ☐
 (d) None of the above ☐

147. Length of the polar normal at any point on the curve $r=f(\theta)$ is given by

- (a) $\sqrt{1+\operatorname{cosec}^2 \phi}$ ☐
 (b) $\sqrt{1+\tan^2 \phi}$ ☐
 (c) $\sqrt{1+r^2\left(\frac{d\theta}{dr}\right)^2}$ ☐
 (d) $\sqrt{r^2+\left(\frac{dr}{d\theta}\right)^2}$ ☐

148. The pedal equation of a curve $r=f(\theta)$ can be obtained by eliminating

- (a) θ and ϕ between $r=f(\theta)$ and $\tan \phi = r \frac{d\theta}{dr}$ ☐
 (b) θ and ϕ between $\frac{1}{p^2} = \frac{1}{r^2} + \frac{1}{r^4} \left(\frac{dr}{d\theta}\right)^2$ and $\tan \phi = r \frac{d\theta}{dr}$ ☐
 (c) θ between $r=f(\theta)$ and $\frac{1}{p^2} = \frac{1}{r^2} + \frac{1}{r^4} \left(\frac{dr}{d\theta}\right)^2$ ☐
 (d) θ and ϕ between $r=f(\theta)$ and $p=r \sin \phi$ ☐

149. If P and Q are any two points on the curve such that the arc PQ is throughout its

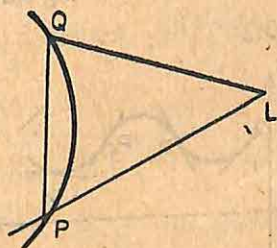


Fig. 3'1.

length concave to the chord PQ and PL and QL are any two lines enclosing the curve, then

- (a) chord $PQ < PL + QL < \text{arc } PQ$ ☐
 (b) arc $PQ < PL + QL < \text{chord } PQ$ ☐
 (c) chord $PQ < \text{arc } PQ < PL + QL$ ☐
 (d) $PL + QL < \text{chord } PQ < \text{arc } PQ$ ☐

150. If P and Q are any two points on the curve then what is

$$\lim_{Q \rightarrow P} \frac{\text{arc } PQ}{\text{chord } PQ} ?$$

- (a) 0 ☐
 (b) 1 ☐
 (c) Indeterminate ☐
 (d) None of the above ☐

151. Derivative of the length of an arc of a given curve w.r.t. x is given by

- (a) $\sqrt{1+\left(\frac{dy}{dx}\right)^2}$ ☐
 (b) $\sqrt{dx^2+dy^2}$ ☐
 (c) $\sqrt{1+\left(\frac{dx}{dy}\right)^2}$ ☐
 (d) dx^2+dy^2 ☐

152. $\cos \psi$ is equal to

- (a) $\frac{dy}{ds}$ ☐
 (b) $\frac{dy}{dx}$ ☐
 (c) $\frac{dx}{ds}$ ☐
 (d) $\frac{ds}{dx}$ ☐

153. Derivative of the length of an arc of a given curve w.r.t. θ is given by

- (a) $\sqrt{r^2+\left(\frac{dr}{d\theta}\right)^2}$ ☐
 (b) $\sqrt{1+\left(r \frac{dr}{d\theta}\right)^2}$ ☐
 (c) $\sqrt{r^2+\left(\frac{d\theta}{dr}\right)^2}$ ☐
 (d) $\sqrt{dr^2+(rd\theta)^2}$ ☐

154. Derivative of the length of an arc of a given curve w.r.t. the radius vector is given by

(a) $\sqrt{r^2 + \left(\frac{dr}{d\theta}\right)^2}$ ☐

(b) $\sqrt{1 + \left(r \frac{d\theta}{dr}\right)^2}$ ☐

(c) $\sqrt{r^2 + \left(\frac{d\theta}{dr}\right)^2}$ ☐

(d) $\sqrt{dr^2 + d\theta^2}$ ☐

155. $\sin \phi$ is equal to

(a) $\frac{d\theta}{ds}$ ☐

(b) $r \frac{d\theta}{ds}$ ☐

(c) $r \frac{ds}{d\theta}$ ☐

(d) $\frac{ds}{d\theta}$ ☐

156. Let A be any fixed point on the curve and P, Q are two points on the curve such that

Arc $PQ = \delta s$, Arc $AP = s$ and Arc $AQ = s + \delta s$. Let ψ and $\psi + \delta\psi$ be the angle which the tangents at P and Q make with x -axis. Then then total curvature of the arc PQ is defined to be the

(a) Arc δs ☐

(b) Angle $\psi + \delta\psi$ ☐

(c) Angle $\delta\psi$ ☐

(d) None of the above ☐

157. The Average curvature of the arc PQ is defined as

(a) $\frac{\delta s}{\delta\psi}$ ☐

(b) $\frac{ds}{d\psi}$ ☐

(c) $\frac{\delta\psi}{\delta s}$ ☐

(d) $\frac{d\psi}{ds}$ ☐

158. The curvature of the curve at any point $P(x, y)$ is defined as

(a) $\lim_{Q \rightarrow P} \frac{\delta\psi}{\delta s}$ ☐

(b) $\lim_{Q \rightarrow P} \frac{\delta\psi}{\delta x}$ ☐

(c) $\lim_{Q \rightarrow P} \frac{\delta s}{\delta\psi}$ ☐

(d) $\lim_{Q \rightarrow P} \frac{\delta x}{\delta\psi}$ ☐

where Q is a point on the curve near to P .

159. The curvature at any point of a circle is

(a) Same as its radius ☐

(b) Same as its diameter ☐

(c) Reciprocal of its radius ☐

(d) None of the above ☐

160. The radius of curvature for any point on the curve $y=f(x)$ is given by

(a) $\rho = \frac{(1+y_2^2)^{3/2}}{y_1}$ ☐

(b) $\rho = \frac{\sqrt{1+y_1^2}}{y_2}$ ☐

(c) $\rho = \frac{\sqrt{(1+y_1^2)^3}}{y_2}$ ☐

(d) $\rho = \frac{(1+y_1^2)^3}{y_2}$ ☐

161. Let P be any point on the curve $y=f(x)$. Then P is said to be a point of inflexion if the two portions of the curve on the two sides of P lie

(a) On different sides of the tangent at P ☐

(b) Below the tangent at P ☐

(c) Above the tangent at P ☐

(d) Below or above the tangent at P ☐

162. Which of the following statements is wrong?

In figure 3.2

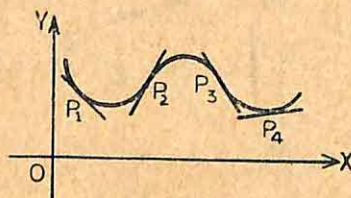


Fig. 3.2.

- (a) The curve is concave upwards at every point between P_1 and P_2 ☐
- (b) P_2 and P_3 are the points of inflexion on the curve ☐
- (c) The curve is convex upwards at every point between P_3 and P_4 ☐
- (d) The curve is concave downwards at every point between P_2 and P_3 ☐

163. The curve $y=f(x)$ has a point of inflexion at $x=c$ on it if

- (a) $f'(c)=0$ but $f''(c)\neq 0$ ☐
- (b) $f''(c)=0$ but $f'''(c)>0$ ☐
- (c) $f''(c)=0$ but $f'''(c)\neq 0$ ☐
- (d) $f''(c)=0$ but $f'''(c)<0$ ☐

164. The curve $y=f(x)$ is concave upwards at $x=c$ if

- (a) $f'(c)>0$ ☐
- (b) $f'(c)<0$ ☐
- (c) $f''(c)<0$ ☐
- (d) $f''(c)>0$ ☐

165. The curve $y=f(x)$ is concave downwards at $x=c$ if

- (a) $f(c)<0$ ☐
- (b) $f'(c)<0$ ☐
- (c) $f''(c)<0$ ☐
- (d) $f'''(c)<0$ ☐

166. Which of the following statements is incorrect?

The curve $y=f(x)$ has a point of inflexion at $x=c$ if

- (a) $f''(x)$ changes sign from positive to negative as x passes through c ☐
- (b) $f''(x)$ changes sign from negative to positive as x passes through c ☐
- (c) Either (a) or (b) holds ☐
- (d) $f''(x)$ does not change sign as x passes through c ☐

167. The curve $y=e^x$ has how many points of inflexion?

- (a) None ☐
- (b) One ☐
- (c) Two ☐
- (d) Three ☐

168. The curve $y=3x^5-30x^4+3x-20$ has how many points of inflexions?

- (a) None ☐

- (b) One ☐
- (c) Two ☐
- (d) Four ☐

169. The points of inflexion of the curve $r=f(\theta)$ are given by

- (a) $\frac{dp}{dr}=0$ ☐
- (b) $u+\frac{d^2u}{d\theta^2}=0$ ☐
- (c) $r^2+2\left(\frac{dr}{d\theta}\right)^2-r\frac{d^2r}{d\theta^2}=0$ ☐
- (d) All of the above ☐

170. A double point P is called a node if the two tangents at P are

- (a) Imaginary ☐
- (b) Real and coincident ☐
- (c) Real and different ☐
- (d) One real and the other imaginary ☐

171. On which of the following curves, origin is a cusp?

- (a) $x^3+y^3-3axy=0$ ☐
- (b) $x^2y^2+a^2(x^2-y^2)=0$ ☐
- (c) $y(x^2+y^2)-ax^2=0$ ☐
- (d) $(x^2+y^2)^2=a^2x^2+b^2y^2$ ☐

172. On which of the four curves (a), (b), (c) and (d) in Q 171, the origin is a node?

- (a) (a) and (b) ☐
- (b) (d) ☐
- (c) (b) and (d) ☐
- (d) (c) and (d) ☐

173. On which of the four curves (a), (b), (c), (d) in Q, 171, the origin is an isolated (conjugate) point?

- (a) (a) ☐
- (b) (b) ☐
- (c) (c) ☐
- (d) (d) ☐

174. The point $P(x, y)$ on the curve $f(x, y)=0$ is said to be a multiple point of the curve iff (x, y) satisfies

- (a) $\left(\frac{\partial f}{\partial x}\right)_{(x, y)}=0$ and $f(x, y)=0$ ☐
- (b) $\left(\frac{\partial f}{\partial y}\right)_{(x, y)}=0$ and $f(x, y)=0$ ☐

$$(c) \left(\frac{\partial f}{\partial x} \right)_{(x,y)} = 0, \left(\frac{\partial f}{\partial y} \right)_{(x,y)} = 0$$

and $f(x, y) = 0$ ☐

$$(d) \left(\frac{\partial f}{\partial x} \right)_{(x,y)} = 0, \left(\frac{\partial f}{\partial y} \right)_{(x,y)} = 0$$
 ☐

175. If $\frac{\partial^2 f}{\partial x^2}$, $\frac{\partial^2 f}{\partial x \partial y}$ and $\frac{\partial^2 f}{\partial y^2}$ are not all zero and $\frac{\partial f}{\partial x} = 0$, $\frac{\partial f}{\partial y} = 0$; then the point

$P(x, y)$ is a double point of the curve $f(x, y) = 0$ and is a cusp if

$$\left(\frac{\partial^2 f}{\partial x \partial y} \right)^2 - \frac{\partial^2 f}{\partial x^2} \frac{\partial^2 f}{\partial y^2} \text{ is}$$

- (a) Greater than zero ☐
 (b) Less than zero ☐
 (c) Equal to zero ☐
 (d) None of the above ☐

176. The number of the multiple points on the curve

$$x^4 - 2ay^3 - 3a^2y^2 - 2a^2x^2 + a^4 = 0 \text{ is}$$

- (a) 6 ☐
 (b) 4 ☐
 (c) 3 ☐
 (d) 2 ☐

177. The number of double points on the curve $x^4 + y^3 + 2x^2 + 3y^2 = 0$ is

- (a) None ☐
 (b) One ☐
 (c) Two ☐
 (d) Four ☐

178. At a point of inflexion, the curvature is

- (a) Zero ☐
 (b) Nonzero ☐
 (c) Infinite ☐
 (d) Any nonzero finite number ☐

179. If x -axis is the tangent at the origin, then $\rho_{(0,0)}$ is equal to

- (a) $\lim_{x \rightarrow 0} \frac{y^2}{2x}$ ☐
 (b) $\lim_{x \rightarrow 0} \frac{y}{2x}$ ☐

$$(c) \lim_{x \rightarrow 0} \frac{x^2}{2y}$$
 ☐

$$(d) \lim_{x \rightarrow 0} \frac{x}{2y}$$
 ☐

180. The formulas for calculating the radius of curvature at the origin are due to

- (a) Lagrange ☐
 (b) Einstein ☐
 (c) Newton ☐
 (d) Taylor ☐

181. If the initial line is tangent at the origin of the given curve $r = f(\theta)$, the radius of curvature at the origin for that curve is given by

$$(a) \lim_{\theta \rightarrow 0} \frac{r}{2 \sin \theta}$$
 ☐

$$(b) \lim_{\theta \rightarrow 0} \frac{r}{2 \cos \theta}$$
 ☐

$$(c) \lim_{\theta \rightarrow 0} \frac{r}{2\theta}$$
 ☐

$$(d) \lim_{\theta \rightarrow 0} \frac{r \cos \theta}{2}$$
 ☐

182. If Y -axis be the tangent at the origin of the given curve $r = f(\theta)$, the value of $\rho_{(0,0)}$ is given by

$$(a) \lim_{\theta \rightarrow 0} \frac{r}{2 \cos \theta}$$
 ☐

$$(b) \lim_{\theta \rightarrow \pi/2} \frac{r}{2 \sec \theta}$$
 ☐

$$(c) \lim_{\theta \rightarrow \pi/2} \frac{r}{2 \sin \theta}$$
 ☐

$$(d) \lim_{\theta \rightarrow \pi/2} \frac{r}{2 \cos \theta}$$
 ☐

183. The value of ρ at any point of the curve $s = c \log \sec \psi$ is given by

$$(a) c \cos \psi$$
 ☐

$$(b) \frac{1}{c} \cot \psi$$
 ☐

$$(c) \frac{1}{c} \tan \psi$$
 ☐

$$(d) c \tan \psi$$
 ☐

184. How many values of $\rho(0, 0)$ are expected for the curve

$$y^2 - 3xy + 2x^2 - x^3 + y^4 = 0?$$

- (a) One ☐
 (b) Two ☐
 (c) Three ☐
 (d) Four ☐

185. For the curve $r=f(\theta)$ (where the symbol have their usual meanings)

- (a) $\psi + \theta = \phi$ ☐
 (b) $\psi - \phi = \theta$ ☐
 (c) $\psi = \theta - \phi$ ☐
 (d) None of the above ☐

186. Radius of curvature at any point of the curve $r=f(\theta)$, is given by

- (a) $\rho = \frac{(r^2 + r_1^2)^{\frac{3}{2}}}{r^2 + 2r_1^2 - rr_2}$ ☐
 (b) $\rho = \frac{(r^2 + r_1^2)^{\frac{1}{2}}}{r^2 + 2r_1^2 - rr_2}$ ☐
 (c) $\rho = \frac{r^2 + r_1^2}{r^2 + 2r_1^2 - rr_2}$ ☐
 (d) $\rho = \frac{(r^2 + r_1^2)^{\frac{3}{2}}}{r^2 - 2r_1^2 + rr_2}$ ☐

187. The radius of curvature at any point of the pedal curves is given by

- (a) $\rho = r \cdot \frac{dp}{dr}$ ☐
 (b) $\rho = r \cdot \frac{dr}{dp}$ ☐
 (c) $\rho = \frac{1}{r} \cdot \frac{dp}{dr}$ ☐
 (d) $\rho = \frac{1}{r} \cdot \frac{dr}{dp}$ ☐

188. The radius of curvature at any point of the tangential polar curves is given by

- (a) $\rho = p + \frac{d^2p}{d\psi^2}$ ☐
 (b) $\rho = \frac{dp}{d\psi} + \frac{d^2p}{d\psi^2}$ ☐

(c) $\rho = p + \frac{dp}{d\psi}$ ☐

(d) $\rho = \frac{1}{p} + \frac{d^2p}{d\psi^2}$ ☐

189. The coordinates of the centre of curvature for any point P on the curve are given by

(a) $X = x - \frac{y_1}{y_2} \sqrt{1 + y_1^2}$ ☐

$Y = y + \frac{1 + y_1^2}{y_2}$ ☐

(b) $X = x - \rho \sin \psi$
 $Y = y + \rho \cos \psi$ ☐

(c) $X = x - \frac{dy}{d\psi}$ ☐

$Y = y + \frac{dx}{d\psi}$ ☐

(d) All the above ☐

190. Which of the following statements is correct? Chord of curvature

- (a) Parallel to X -axis is $\rho \cos \psi$ ☐
 (b) Parallel to Y -axis is $\rho \sin \psi$ ☐
 (c) Through the pole is $2\rho \sin \phi$ ☐
 (d) All of the above ☐

191. Which of the following statements is incorrect?

The chord of curvature

- (a) Parallel to X -axis is $2\rho \sin \psi$ ☐
 (b) Perpendicular to the radius vector is $2\rho \cos \phi$ ☐
 (c) Parallel to Y -axis is $2\rho \cos \psi$ ☐
 (d) All of the above ☐

192. An asymptote of an infinite branch of a curve is a straight line if the perpendicular distance of the point P on the curve from the straight line tends to— as P recedes to infinity

- (a) ∞ ☐
 (b) 0 ☐
 (c) Either ∞ or 0 ☐
 (d) $-\infty$ ☐

193. The asymptote not parallel to y axis is of the type $y = mx + c$, where m is its slope and c is the intercept made by the asym-

ptote on y -axis. Then m and c can be obtained by finding $\text{Lt } (y/x)$ and $\text{Lt } (y-mx)$ respectively as x tends to

- (a) 0 ☐
 (b) $-\infty$ ☐
 (c) ∞ ☐
 (d) 1 ☐

194. The folium $x^3 + y^3 - 3axy = 0$ has how many asymptotes?

- (a) None ☐
 (b) One ☐
 (c) Two ☐
 (d) Three ☐

195. What are the asymptotes of the curve $y = \tan x$?

(a) $x = (2n+1)\frac{\pi}{2}$, where n is any integer ☐

(b) $x = n\pi$, where n is any integer ☐

(c) $x = (2n+1)\frac{\pi}{2}$, where n is a positive integer only ☐

(d) None of the above ☐

196. What are the asymptotes of the curve $y = \cot x$?

(a) $x = n\pi$, where n is a positive integer only ☐

(b) $x = n\pi$, where n is a negative integer only ☐

(c) $x = 0$ only ☐

(d) None of the above ☐

197. Asymptotes parallel to Y -axis and X -axis are obtained by equating to zero, the

(a) Co-efficient of the highest power of x and highest power of y respectively in the equation of the curve ☐

(b) Co-efficient of the highest power of y and highest power of x respectively in the equation of the curve ☐

(c) Real linear factors in the coefficient of the highest power of x and highest power of y respectively in the equation of the curve ☐

(d) Real linear factors in the coefficient of the highest power of y and highest power of x respectively in the equation of the curve ☐

198. The asymptotes of the general rational algebraic equation

$$U_n + U_{n-1} + U_{n-2} + \dots + U_0 = 0,$$

where U_r is a homogeneous expression of degree r , in x and y and is put in the form $U_r = x^r \phi_r(y/x)$ where $\phi_r(y/x)$ is a polynomial in y/x of degree r at most, are given by

(a) $y = mx + \frac{\phi_{n-1}(m)}{\phi_n'(m)}$ ☐

(b) $y = mx - \frac{\phi_{n-1}(m)}{\phi_n'(m)}$ ☐

(c) $y = mx - \frac{\phi_{n-1}(m)}{\phi_n'(m)}$, $\phi_n'(m) \neq 0$ ☐

(d) $y = mx + \frac{\phi_{n-1}(m)}{\phi_n'(m)}$, $\phi_n'(m) \neq 0$ ☐

199. The polynomial $\phi_n(m)$ can be obtained by putting $x=1$ and $y=m$ in

(a) The highest degree terms ☐

(b) The lowest degree terms ☐

(c) Coefficient of highest power of y ☐

(d) Coefficient of highest power of x ☐

200. The equation $\phi_n(x, y) = 0$ gives a line through the origin and parallel to the

(a) X -axis ☐

(b) Y -axis ☐

(c) Asymptotes ☐

(d) Line perpendicular to the asymptotes ☐

201. An algebraic curve of odd degree has—real asymptotes

(a) No ☐

(b) At the most one ☐

(c) At least one ☐

(d) At least two ☐

202. An asymptote of a curve of n th degree cut it in

(a) n points ☐

(b) $(n-2)$ points ☐

(c) $n(n-2)$ points ☐

(d) Only one point ☐

203. The curve is symmetrical about X-axis if

- (a) The powers of x which occur in its equation are all even ☐
- (b) The powers of y which occur in its equation are all even ☐
- (c) On interchanging x and y its equation does not change ☐
- (d) The powers of y , which occur in its equation, are ≥ 2 ☐

204. The curve

$$y^2(a^2 + x^2) = x^2(a^2 - x^2)$$

is symmetrical about

- (a) X-axis ☐
- (b) Y-axis ☐
- (c) Both the axes ☐
- (d) The line $y=x$ ☐

205. The calculation of which of the following is most helpful in tracing of curves represented by cartesian equations?

- (a) Asymptotes ☐
- (b) Tangents at the origin ☐
- (c) Singular points ☐
- (d) $\frac{dy}{dx}$ ☐

206. The curve traced below is named as

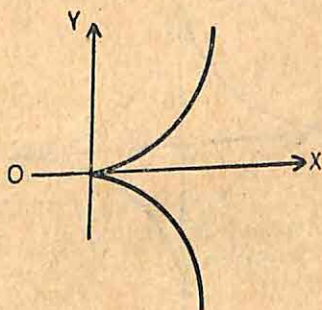


Fig. 3.3

- (a) Strophoid ☐
- (b) Cissoid of Diocles ☐
- (c) Hypocycloid ☐
- (d) Epicycloid ☐

207. The curve traced below is named as

- (a) Parabola ☐
- (b) Catenary ☐

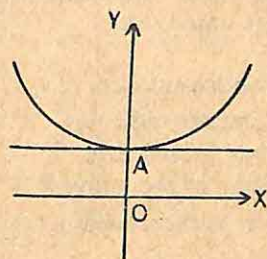


Fig. 3.4

- (c) Cycloid ☐
- (d) None of the above ☐

208. The curve traced below is named as

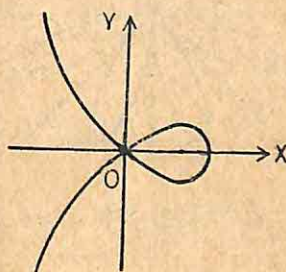


Fig. 3.5

- (a) Cissoid of Diocles ☐
- (b) Lemniscate of Bernouille ☐
- (c) Strophoid ☐
- (d) Cardioid ☐

209. The curve traced below is named as

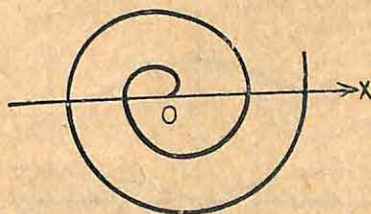


Fig. 3.6

- (a) Spiral of Archimedes ☐
- (b) Equiangular spiral ☐
- (c) Hyperbolic spiral ☐
- (d) None of the above ☐

210. The curve represented by the equation $r = a \sin 2\theta$ is named as

- (a) Two leaved rose ☐
 (b) Three leaved rose ☐
 (c) Four leaved rose ☐
 (d) None of the above ☐

211. The curve traced below is represented by

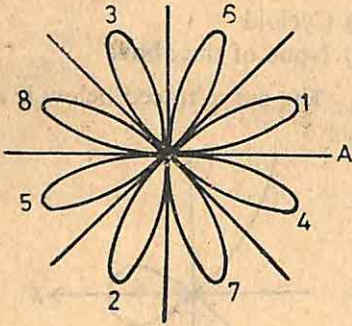


Fig. 3.7

- (a) $r = a \sin 8\theta$ ☐
 (b) $r = a \sin 4\theta$ ☐
 (c) $r = a \sin 10\theta$ ☐
 (d) None of the above ☐

212. The curve traced below is named as

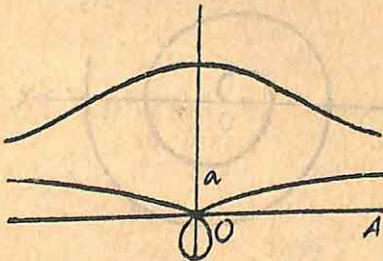


Fig. 3.8

- (a) Cycloid ☐
 (b) Cardioid ☐

- (c) Conicoid of Nicomedes ☐
 (d) Witch of Agnesi ☐

213. The curve traced below is named as

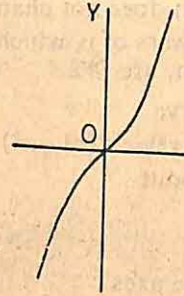


Fig. 3.9.

- (a) Cubical parabola ☐
 (b) Semi-cubical parabola ☐
 (c) Catenary ☐
 (d) Witch of Agnesi ☐

214. The curve traced below is named as

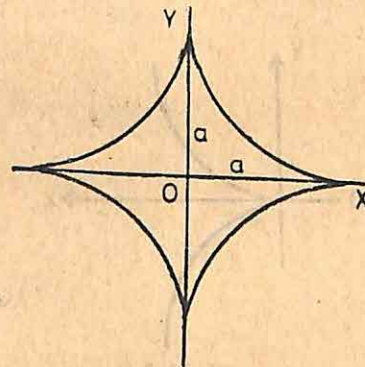


Fig. 3.10

- (a) Evolute of an ellipse ☐
 (b) Astroid ☐
 (c) Cubical parabola ☐
 (d) None of the above ☐

215. The curve traced below is named as

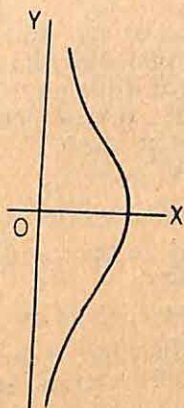


Fig. 3.11

- (a) Witch of Agnesi ☐
 (b) Conicoid of Nicomedes ☐
 (c) Cardioide ☐
 (d) none of the above ☐

216. $\lim_{k \rightarrow 0} \frac{f(x, y+k) - f(x, y)}{k}$ is called the

- (a) Derivative of f with respect to x ☐
 (b) Derivative of f with respect to y ☐
 (c) Partial derivative of f with respect to x ☐
 (d) Partial derivative of f with respect to y ☐

217. f_{xx} means

- (a) $\left(\frac{\partial f}{\partial x}\right)^2$ ☐
 (b) $\frac{\partial f}{\partial x}$ ☐
 (c) $\frac{\partial^2 f}{\partial x^2}$ ☐
 (d) None of the above ☐

218. z is a homogeneous function of x and y of degree n , if it is expressible as

- (a) $x f(y/x)$ ☐
 (b) $x^n f(y/x)$ ☐
 (c) $x f^n(y/x)$ ☐
 (d) $x^{n-1} f(y/x)$ ☐

219. The function $z = \frac{\sqrt{y} + \sqrt{x}}{y+x}$ is a

- (a) Homogeneous function of degree $\frac{1}{2}$ ☐
 (b) Non-homogeneous function of degree $-\frac{1}{2}$ ☐
 (c) Non-homogeneous function of degree $\frac{1}{2}$ ☐
 (d) None of the above ☐

220. If z be a homogeneous function of x and y of degree n , then

$$x \frac{\partial z}{\partial x} + y \frac{\partial z}{\partial y} = nz$$

This is known as

- (a) Taylor's theorem on homogeneous functions ☐
 (b) Euler's theorem on homogeneous functions ☐
 (c) Cauchy's theorem on homogeneous functions ☐
 (d) Leibnitz theorem on homogeneous functions ☐

221. What is the degree of the homogeneous fn. of x and y

$$z = \frac{x^3 + y^3}{x - y}$$

- (a) 3 ☐
 (b) 2 ☐
 (c) $3/2$ ☐
 (d) None of the above ☐

222. $\frac{\partial^2 z}{\partial x^2}$ for the fn. $z = e^{x-y}$ of x and y is

given by

- (a) z ☐
 (b) e^z ☐
 (c) $1/z$ ☐
 (d) None of the above ☐

223. If $z = xy f(y/x)$, then

$$x \frac{\partial z}{\partial x} + y \frac{\partial z}{\partial y} \text{ is equal to}$$

- (a) z ☐
 (b) $2z$ ☐
 (c) 0 ☐
 (d) None of the above ☐

224. If $f(x, y)$ be any function of two variables x and y and $f(x, y) = 0$, then

$$\frac{dy}{dx} \text{ is equal to}$$

- (a) $\frac{f_x}{f_y}$ ☐
 (b) $-\frac{f_x}{f_y}$ ☐
 (c) $\frac{f_y}{f_x}$ ☐

$$(d) -\frac{f_y}{f_x} \quad \square$$

225. If $f(x, y)$ be any function of two variables x and y and $f(x, y)=0$, then

$\frac{d^2y}{dx^2}$ is equal to

$$(a) -\frac{\left(\frac{\partial f}{\partial x}\right)^2}{\left(\frac{\partial f}{\partial y}\right)^2} \quad \square$$

$$(b) \frac{-\frac{\partial f}{\partial y} \cdot \frac{\partial^2 f}{\partial x^2} + \frac{\partial f}{\partial x} \frac{\partial^2 f}{\partial x \partial y}}{\left(\frac{\partial f}{\partial y}\right)^2} \quad \square$$

$$(c) \frac{\frac{\partial^2 f}{\partial x^2} \left(\frac{\partial f}{\partial y}\right)^2 - 2 \frac{\partial^2 f}{\partial y \partial x} \frac{\partial f}{\partial x} \frac{\partial f}{\partial y}}{\left(\frac{\partial f}{\partial y}\right)^3} \quad \square$$

(d) None of the above ☐

226. Rolle's theorem is not satisfied for the function $f(x) = |x|$ in $[-1, 1]$ because of the reason that

(a) $f(x)$ is not continuous in $[-1, 1]$ ☐

(b) $f(-1) \neq f(1)$ ☐

(c) $f'(x)$ does not exist for $x=0$ which is a point of the interval $[-1, 1]$ but $f'(x)$ exists and is nonzero elsewhere so that $f'(x)$ nowhere vanishes ☐

(d) $f(x)$ is derivable at $x=0$ ☐

227. Consider the function $f(x)=x^2$. How many values of x exist in $[-1, 1]$, the tangent (to the given curve) at which is parallel to x -axis

(a) None ☐

(b) One ☐

(c) Two ☐

(d) Infinite ☐

228. For which of the following functions Rolle's Theorem is not satisfied?

(a) $f(x)=x^2$ in $[2, 3]$ ☐

(b) $f(x)=\cos 1/x$ in $[-1, 1]$ ☐

(c) $f(x)=\tan x$ in $[0, \pi]$ ☐

(d) All of the above ☐

229. Give geometrical statement of the Lagrange's mean value theorem. If a curve has a tangent at each of its points, then $\exists$ at least one point on the curve, other than its extremities, the tangent at which

(a) Is parallel to x -axis ☐

(b) Is parallel to y -axis ☐

(c) Is parallel to the chord joining its extremities ☐

(d) Makes an angle of 45° with x -axis ☐

230. For the function $f(x)=x(x-1)(x-2)$ the value of c of the mean value theorem in $[0, \frac{1}{2}]$ is given by

$$(a) \frac{6+\sqrt{21}}{6} \quad \square$$

$$(b) \frac{6-\sqrt{21}}{6} \quad \square$$

$$(c) 1-\sqrt{21} \quad \square$$

(d) None of the above ☐

231. If $f(x)$ is derivable in $[a, a+h]$, then $\exists$ at least one number θ such that $f(a+h)-f(a)=hf'(a+\theta h)$. The number θ has the value

(a) 0 ☐

(b) Less than 0 ☐

(c) Between 0 and 1 ☐

(d) None of the above ☐

232. If $f(x)$ and $F(x)$ both have the same derivative for every value of x in $[a, b]$, then

(a) $f(x)$ and $F(x)$ are of opposite signs ☐

(b) $f(x)=F(x)$ ☐

(c) $f(x)$ and $F(x)$ are both even functions of x ☐

(d) $f(x)$ and $F(x)$ differ only by a constant ☐

234. If $f(x)$, $\phi(x)$ and $\psi(x)$ have derivatives when $a < x < b$, then $\exists$ a value ξ of x lying between a and b such that

$$(a) \begin{vmatrix} f(a) & \phi(a) & \psi(a) \\ f'(b) & \phi'(b) & \psi'(b) \\ f''(c) & \phi''(c) & \psi''(c) \end{vmatrix} = 0 \quad \square$$

$$\begin{aligned}
 (b) \quad & \begin{vmatrix} f(a) & \phi'(a) & \psi''(a) \\ f(b) & \phi'(b) & \psi''(b) \\ f(c) & \phi'(c) & \psi''(c) \end{vmatrix} = 0 \quad \square \\
 (c) \quad & \begin{vmatrix} f(a) & \phi(a) & \psi(a) \\ f(b) & \phi(b) & \psi(b) \\ f'(c) & \phi'(c) & \psi'(c) \end{vmatrix} = 0 \quad \square \\
 (d) \quad & \begin{vmatrix} f'(a) & \phi'(a) & \psi'(a) \\ f'(b) & \phi'(b) & \psi'(b) \\ f'(c) & \phi'(c) & \psi'(c) \end{vmatrix} = 0 \quad \square
 \end{aligned}$$

234. If two functions $f(x)$ and $F(x)$ are derivable in an interval $[a, b]$ and $F(x) \neq 0$ for any value of x in $[a, b]$, then $\exists$ at least one value c of x in $[a, b]$ such that

$$\frac{f(b)-f(a)}{F(b)-F(a)} = \frac{f'(c)}{F'(c)}$$

This is Cauchy's mean value theorem which reduces to the Lagrange's mean value theorem if we put

- (a) $f(x)=x$ ☐
 (b) $F(x)=x$ ☐
 (c) $f(x)=x^2$ ☐
 (d) $F(x)=x^2$ ☐

Thus Lagrange's mean value theorem is a particular case of Cauchy's mean value theorem.

235. If in Q. 117, in the Cauchy's mean value theorem, we put $f(x)=x^2$ and $F(x)=x$, then c is the

- (a) Arithmetic mean of a and b ☐
 (b) Geometric mean of a and b ☐
 (c) Harmonic mean of a and b ☐
 (d) Product of a and b ☐

236. If in the Cauchy's mean value theorem, we put $f(x)=\sqrt{x}$ and $F(x)=1/\sqrt{x}$, then c is the

- (a) Product of a and b ☐
 (b) A.M. of a and b ☐
 (c) G.M. of a and b ☐
 (d) H.M. of a and b ☐

237. If in the Cauchy's mean value theorem, we put $f(x)=\frac{1}{x^2}$ and $F(x)=\frac{1}{x}$, then c is the

- (a) H.M. of a and b ☐
 (b) G.M. of a and b ☐
 (c) A.M. of a and b ☐
 (d) Product of a and b ☐

238. If in the Cauchy's mean value theorem, we put $f(x)=e^x$ and $F(x)=e^{-x}$ then c is

- (a) 1 ☐
 (b) e^{2x} ☐
 (c) e^{-2x} ☐
 (d) A.M. of a and b ☐

$$\begin{aligned}
 239. \quad & x - \frac{x^2}{2} + \frac{x^3}{3} - \dots + (-1)^{n-2} \frac{x^{n-1}}{n-1} \\
 & + (-1)^{n-1} \frac{x^n}{n(1+\theta x)^n}
 \end{aligned}$$

is equal to

- (a) $\log(1-x)$ ☐
 (b) e^{-x} ☐
 (c) $\log(1+x)$ ☐
 (d) $\sin x$ ☐

$$240. \quad f(x) - xf'(x) + \frac{x^2}{2} f''(x) - \frac{x^3}{3} f'''(x)$$

+....., is equal to

- (a) $f(-x)$ ☐
 (b) $f(1+x)$ ☐
 (c) $f(0)$ ☐
 (d) None of the above ☐

$$241. \quad f(x) - \frac{x}{1+x} f'(x) + \frac{x^2}{(1+x)^2} f''(x) -$$

..... is equal to

- (a) $f\left(\frac{x^2}{1-x^2}\right)$ ☐
 (b) $f\left(\frac{x}{1+x}\right)$ ☐
 (c) $f\left(\frac{x^2}{1+x}\right)$ ☐
 (d) None of the above ☐

242. If, under certain conditions,

$$f(a+h) = f(a) + hf'(a) + \frac{1}{2} h^2 f''(a + \theta h), 0 < \theta < 1,$$

then as $h \rightarrow 0$, $\theta \rightarrow$

- (a) 0 ☐
 (b) $\frac{1}{2}$ ☐

(c) $\frac{1}{3}$ ☐

(d) 1 ☐

243. The function $f(x) = x^{\frac{1}{x}}$ has a minimum value at

(a) $x=e$ ☐

(b) $x=e^{-1}$ ☐

(c) $x=e^2$ ☐

(d) $x=0$ ☐

244. The maximum value of $\frac{\log x}{x}$ in

$(0, \infty)$ is

(a) e ☐

(b) $\frac{1}{e}$ ☐

(c) e^2 ☐

(d) None of the above ☐

245. The polynomial $8x^5 - 15x^4 + 10x^2$ has neither a maximum nor a minimum value at

(a) $x=0$ ☐

(b) $x = \frac{-1}{2}$ ☐

(c) $x=1$ ☐

(d) $x=-1$ ☐

246. If $x+3y=60$, then find the numbers x and y such that xy is maximum

(a) 33 and 9 ☐

(b) 27 and 11 ☐

(c) 30 and 10 ☐

(d) None of the above ☐

247. The coordinates of a point on the parabola $y=x^2$ nearest to the point $(3, 0)$ are

(a) $(0, 0)$ ☐

(b) $(1, 0)$ ☐

(c) $(0, 1)$ ☐

(d) $(1, 1)$ ☐

248. Area of the greatest rectangle that can be inscribed in the ellipse

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1, \text{ is}$$

(a) ab ☐

(b) $\sqrt{ab}$ ☐

(c) $\frac{a}{b}$ ☐

(d) $2ab$ ☐

249. The slope of the tangent to the curve $y=f(x)$ at any point (x, y) is given by

(a) $\frac{x}{y}$ ☐

(b) $\frac{y}{x}$ ☐

(c) $-1/\frac{dy}{dx}$ ☐

(d) $\frac{dy}{dx}$ ☐

250. The equation of the tangent to the curve $f(x, y)=0$ at any point (x, y) is given by

(a) $(X-x)\frac{\partial f}{\partial y} + (Y-y)\frac{\partial f}{\partial x} = 0$ ☐

(b) $(X-x)\frac{\partial f}{\partial y} - (Y-y)\frac{\partial f}{\partial x} = 0$ ☐

(c) $(Y-y)\frac{\partial f}{\partial y} + (X-x)\frac{\partial f}{\partial x} = 0$ ☐

(d) $(X-x)\frac{\partial f}{\partial x} - (Y-y)\frac{\partial f}{\partial y} = 0$ ☐

251. The slope of the tangent to the curve $f(x, y)=0$ at any point (x, y) is given by

(a) $\frac{\partial f}{\partial x} / \frac{\partial f}{\partial y}$ ☐

(b) $-\frac{\partial f}{\partial x} / \frac{\partial f}{\partial y}$ ☐

(c) $\frac{\partial f}{\partial y} / \frac{\partial f}{\partial x}$ ☐

(d) $-\frac{\partial f}{\partial y} / \frac{\partial f}{\partial x}$ ☐

252. The equation of tangent to the curve $x=f(t)$ and $y=F(t)$ at any point (x, y) is given by

(a) $[X-f(t)]F'(t) - [Y-F(t)]f'(t) = 0$ ☐

(b) $[X-f(t)]f'(t) - [Y-F(t)]F'(t) = 0$ ☐

(c) $[X-f(t)]F'(t) + [Y-F(t)]f'(t) = 0$ ☐

(d) $[X-f(t)]f'(t) + [Y-F(t)]F'(t) = 0$ ☐

253. The slope of tangent to the curve $x=f(t)$ and $y=F(t)$ at any point (x, y) is given by

(a) $\frac{f'(t)}{F'(t)}$ ☐

(b) $\frac{F'(t)}{f'(t)}$ ☐

(c) $-\frac{f'(t)}{F'(t)}$ ☐

(d) $-\frac{F'(t)}{f'(t)}$ ☐

254. The slope of the normal to the curve $f(x, y)=0$ at any point (x, y) is given by

(a) $\frac{\partial f}{\partial y} / \frac{\partial f}{\partial x}$ ☐

(b) $-\frac{\partial f}{\partial y} / \frac{\partial f}{\partial x}$ ☐

(c) $\frac{\partial f}{\partial x} / \frac{\partial f}{\partial y}$ ☐

(d) $-\frac{\partial f}{\partial x} / \frac{\partial f}{\partial y}$ ☐

255. The equation of the normal to the curve $f(x, y)=0$ at any point (x, y) is given by

(a) $(X-x) \frac{\partial f}{\partial y} + (Y-y) \frac{\partial f}{\partial x} = 0$ ☐

(b) $(X-x) \frac{\partial f}{\partial y} - (Y-y) \frac{\partial f}{\partial x} = 0$ ☐

(c) $(X-x) \frac{\partial f}{\partial x} + (Y-y) \frac{\partial f}{\partial y} = 0$ ☐

(d) $(X-x) \frac{\partial f}{\partial x} - (Y-y) \frac{\partial f}{\partial y} = 0$ ☐

256. The equation of the normal to the curve $x=f(t)$, $y=F(t)$ at any point (x, y) is given by

(a) $[X-f(t)]f'(t) + [Y-F(t)]F'(t) = 0$ ☐

(b) $[X-f(t)]f'(t) + [Y-F(t)]F'(t) = 0$ ☐

(c) $[X-f(t)]F'(t) + [Y-F(t)]f'(t) = 0$ ☐

(d) $[X-f(t)]F'(t) - [Y-F(t)]f'(t) = 0$ ☐

257. The slope of the normal to the curve $x=f(t)$, $y=F(t)$ at any point (x, y) is given by

(a) $\frac{F'(t)}{f'(t)}$ ☐

(b) $-\frac{F'(t)}{f'(t)}$ ☐

(c) $\frac{f'(t)}{F'(t)}$ ☐

(d) $-\frac{f'(t)}{F'(t)}$ ☐

258. The slope of the normal to the curve

$$\frac{x^m}{a^m} + \frac{y^m}{b^m} = 1$$

at any point (x, y) is given by

(a) $-\frac{b^m x^{m-1}}{a^m y^{m-1}}$ ☐

(b) $\frac{a^m y^{m-1}}{b^m x^{m-1}}$ ☐

(c) $-\frac{b^m y^{m-1}}{a^m x^{m-1}}$ ☐

(d) $\frac{a^m x^{m-1}}{b^m y^{m-1}}$ ☐

259. The equation of the tangent at the origin for the curve

$$x^3 + y^3 + 3xy + x^2 + 2x + 3y = 0$$

is given by

(a) $x + y = 0$ ☐

(b) $x + 3y = 0$ ☐

(c) $x = 0$ ☐

(d) $2x + 3y = 0$ ☐

260. The tangent to the curve

$$\left(\frac{x}{a}\right)^n + \left(\frac{y}{b}\right)^n = 2$$

at the point (a, b) is given by (whatever may be the value of n)

(a) $\frac{x}{a} + \frac{y}{b} = 2$ ☐

(b) $\frac{x}{a} - \frac{y}{b} = 2$ ☐

(c) $\frac{x}{a} + \frac{y}{b} = 0$ ☐

(d) $\frac{x}{a} - \frac{y}{b} = 0$ ☐

261. The curves $ax^2 + by^2 = 1$ and $a_1x^2 + b_1y^2 = 1$ intersect orthogonally if

- (a) $\frac{1}{b} - \frac{1}{b_1} = \frac{1}{a_1} - \frac{1}{a}$ ☐
- (b) $\frac{1}{b_1} - \frac{1}{b} = \frac{1}{a} - \frac{1}{a_1}$ ☐
- (c) $\frac{1}{b} - \frac{1}{b_1} = \frac{1}{a} - \frac{1}{a_1}$ ☐
- (d) None of the above conditions hold ☐

262. Pedal equation of the ellipse

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

is given by

- (a) $\frac{1}{p^2} = \frac{1}{a^2} + \frac{1}{b^2} - \frac{r^2}{ab}$ ☐
- (b) $\frac{1}{p^2} = \frac{1}{a^2} + \frac{1}{b^2} + \frac{r^2}{a^2b^2}$ ☐
- (c) $\frac{1}{p^2} = \frac{1}{a^2} - \frac{1}{b^2} - \frac{r^2}{a^2b^2}$ ☐
- (d) $\frac{1}{p^2} = \frac{1}{a^2} + \frac{1}{b^2} - \frac{r^2}{a^2b^2}$ ☐

263. Pedal equation of the parabola

$$y^2 = 4a(x+a) \quad \text{is given by}$$

- (a) $p^2 = ar$ ☐
- (b) $r^2 = ap$ ☐
- (c) $p = ar$ ☐
- (d) $p = \frac{a}{r}$ ☐

264. In order to calculate the angle of intersection of two curves

$$r_1 = f(\theta_1) \quad (1)$$

$$r_2 = f(\theta_2) \quad (2)$$

it is necessary to

- (a) Find the pedal equation of (1) and (2) ☐
- (b) Find the pedal equation of either (1) or (2) ☐
- (c) Find the angles between the radius vector and the tangents to (1) (2) at the point of intersection ☐
- (d) Find the equations of tangents to (1) and (2) at any point ☐

265. Length of the perpendicular from the pole on the tangent at any point on the curve $r = f(\theta)$ in terms of $u (= 1/r)$ and θ is given by

(a) $\frac{1}{p^2} = u^2 + \frac{d^2u}{d\theta^2}$ ☐

(b) $p^2 = u^2 + \left(\frac{du}{d\theta}\right)^2$ ☐

(c) $\frac{1}{p^2} = u^2 + \left(\frac{du}{d\theta}\right)^2$ ☐

(d) None of the above ☐

266. The polar subtangent for the curve

$$\frac{l}{r} = 1 + e \cos \theta \quad \text{is given by}$$

(a) $el \operatorname{cosec} \theta$ ☐

(b) $\frac{e}{l} \sin \theta$ ☐

(c) $\frac{l}{e \sin \theta}$ ☐

(d) None of the above ☐

267. The polar subnormal for the curve

$$r = \frac{a}{\theta} \quad \text{is given by}$$

(a) $-\frac{a}{\theta^2}$ ☐

(b) $a\theta^2$ ☐

(c) $-a\theta^2$ ☐

(d) $\frac{a}{\theta}$ ☐

268. The pedal equation of the cardioid $r = a(1 + \cos \theta)$ is given by

(a) $r^2 = 2ap^2$ ☐

(b) $r^2 = 2ap^3$ ☐

(c) $r = 2a \left(\frac{p}{r}\right)^2$ ☐

(d) None of the above ☐

269. Derivative of the length of an arc of a given curve w.r.t. y is given by

(a) $\sqrt{1 + \left(\frac{dy}{dx}\right)^2}$ ☐

(b) $\sqrt{1 + \frac{dy}{dx}}$ ☐

(c) $\sqrt{1 + \left(\frac{dx}{dy}\right)^2}$ ☐

(d) $\sqrt{dx + dy}$ ☐

270. $\sin \psi$ is equal to

(a) $\frac{dy}{ds}$

(b) $\frac{ds}{dy}$

(c) $\frac{dx}{ds}$

(d) $\frac{ds}{dx}$

271. Derivative of the length of an arc of a given curve w.r.t. t is given by

(a) $\sqrt{\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2}$

(b) $\sqrt{1 + \left(\frac{dx}{dt}\right)^2}$

(c) $\sqrt{1 + \left(\frac{dy}{dt}\right)^2}$

(d) $\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2$

272. $\cos \phi$ is equal to

(a) $\frac{ds}{dr}$

(b) $-\frac{dr}{ds}$

(c) $r \frac{dr}{ds}$

(d) $\frac{dr}{ds}$

273. For any curve, $\frac{ds}{d\theta}$ equal to

(a) $\frac{r}{p}$

(b) $\frac{r^2}{p}$

(c) $\frac{p}{r}$

(d) pr^2

274. Radius of curvature at any point of a given curve is the reciprocal of its

(a) Total curvature at that point

- (b) Average curvature at that point
- (c) Curvature at that point
- (d) None of the above

275. When the tangent is perpendicular to x -axis, then ρ is given by

(a) $\frac{1}{\frac{dx}{dy}}$

(b) $\frac{1}{\frac{d^2x}{dy^2}}$

(c) $\frac{1}{\frac{dy}{dx}}$

(d) $\frac{1}{\frac{d^2y}{dx^2}}$

276. The radius of curvature at any point on the curve $f(x, y) = 0$, is given by

(a) $\rho = \frac{(f_x^2 + f_y^2)^{3/2}}{f_{xx}(f_y)^2 - 2f_{xy}f_xf_y + f_{yy}(f_x)^2}$

if f_y is positive

(b) $\rho = \frac{[(f_x)^2 + (f_y)^2]}{f_{xx}(f_y)^2 - 2f_{xy}f_xf_y + f_{yy}(f_x)^2}$

if f_y is negative

(c) $\rho = \frac{-[(f_x)^2 + (f_y)^2]^{3/2}}{f_{xx}(f_y)^2 - 2f_{xy}f_xf_y + f_{yy}(f_x)^2}$

if f_x is positive

(d) $\rho = \frac{-[(f_x)^2 + (f_y)^2]^{3/2}}{f_{xx}(f_y)^2 - 2f_{xy}f_xf_y + f_{yy}(f_x)^2}$

if f_x is negative

277. If $f''(c) = f'''(c) = \dots = f^{n-1}(c) = 0$ but $f^n(c) \neq 0$, then the curve $y = f(x)$ (at $x = c$)

- (a) Has a point of inflexion if n is odd
- (b) Has a point of inflexion if n is even
- (c) Is concave upwards if $f^n(c) > 0$ and n is odd
- (d) Is concave downwards if $f^n(c) > 0$ and n is even

278. What is the condition for a point of inflexion on the curve $r = f(\theta)$

- (a) $\frac{d^2r}{d\theta^2}=0$, but $\frac{d^3r}{d\theta^3}\neq 0$ ☐
- (b) $r^2+2\left(\frac{dr}{d\theta}\right)^2-r\frac{d^2r}{d\theta^2}=0$ ☐
- (c) $\frac{dp}{dr}=0$, where p is the length of the perpendicular from the pole on the tangent at any point (r, θ) on the curve ☐
- (d) Both (b) and (c) ☐
279. The points of inflexion on the curve $x=(\log y)^3$ are
- (a) $y=0$ and $y=e^2$ ☐
- (b) $y=1$ and $y=e$ ☐
- (c) $y=1$ and $y=e^2$ ☐
- (d) $y=0$ and $y=1$ ☐
280. The abscissae of the points of inflexion on the curve $y^2=f(x)$ satisfy the equation
- (a) $f'(x)=2f(x)f''(x)$ ☐
- (b) $[f'(x)]^2=2f''(x)f(x)$ ☐
- (c) $[f'(x)]^2=2f''(x)$ ☐
- (d) $[f(x)]^2=2f'(x)f''(x)$ ☐
281. The point $(-1, -2)$ on the curve $x^3+2x^2+2xy-y^2+5x-2y=0$ is a
- (a) Cusp ☐
- (b) Node ☐
- (c) Conjugate (isolated) point ☐
- (d) Point of inflexion ☐
282. If $\frac{\partial^2 f}{\partial x^2}=\frac{\partial^2 f}{\partial x \partial y}=\frac{\partial^2 f}{\partial y^2}=0$ then the point (x, y) will be a multiple point of order
- (a) Greater than 2 ☐
- (b) 3 ☐
- (c) 4 ☐
- (d) 6 ☐
283. The multiple points on the curve $x^4-2ay^3-3a^2y^2-2a^2x^2+a^4=0$ are
- (a) $(0, 0)$, $(0, -a)$ and $(a, 0)$ ☐
- (b) $(0, -a)$, $(a, 0)$ and $(a, -a)$ ☐
- (c) $(a, 0)$, $(a, -a)$ and $(-a, -a)$ ☐
- (d) $(a, 0)$, $(-a, 0)$ and $(0, -a)$ ☐
284. The cusps are of—types
- (a) 2 ☐
- (b) 4 ☐
- (c) 5 ☐
- (d) 6 ☐
285. The double point $(0, 0)$ on the curve $y^3=x^3+ax^2$ is a
- (a) Node ☐
- (b) Conjugate point ☐
- (c) Cusp ☐
- (d) Point of inflexion ☐
286. How many double points are there on the curve $x^3+3x^2y-4y^3-x+y+3=0$
- (a) Two ☐
- (b) One ☐
- (c) None ☐
- (d) None of the above ☐
287. If the curve is concave upwards, then ρ , the radius of curvature is
- (a) Positive ☐
- (b) Negative ☐
- (c) Zero ☐
- (d) Infinite ☐
288. If x axis is the tangent at the origin, then $\rho(0, 0)$ is given by
- (a) $\lim_{\substack{x \rightarrow 0 \\ y \rightarrow 0}} \frac{x^2+y^2}{2y}$ ☐
- (b) $\lim_{\substack{x \rightarrow 0 \\ y \rightarrow 0}} \frac{x^2}{2y}$ ☐
- (c) $\lim_{\substack{x \rightarrow 0 \\ y \rightarrow 0}} \frac{2y}{x^2+y^2}$ ☐
- (d) Both (a) and (b) above ☐
289. The radius of curvature at the origin of the curve $x^3-2x^2y+3xy^2-4y^3+5x^2-6xy+7y^2-8y=0$ is
- (a) $2/3$ ☐
- (b) $3/2$ ☐
- (c) $4/3$ ☐
- (d) $4/5$ ☐
290. For the ellipse, the value of ρ at any point (x, y) is given by

$$(a) \frac{a^2 b^2}{p^2}$$



$$(b) \frac{a^2 b^2}{p^{3/2}}$$



$$(c) \frac{a^2 b^2}{p^3}$$



$$(d) \frac{a^3 b^3}{p^{3/2}}$$



$$(b) \frac{1}{3\sqrt{3}}$$



$$(c) \frac{\sqrt{2}}{3}$$



$$(d) \frac{2\sqrt{2}}{3}$$



296. At a point of inflexion on a polar curve

$$(a) r^2 + 2 \frac{dr}{d\theta} - \frac{d^2 r}{d\theta^2} = 0$$



$$(b) r^2 + \left(2 \frac{dr}{d\theta} \right)^2 - \frac{d^2 r}{d\theta^2} = 0$$



$$(c) r^2 + 2 \left(\frac{dr}{d\theta} \right)^2 - r \frac{d^2 r}{d\theta^2} = 0$$



$$(d) r^2 - 2 \left(\frac{dr}{d\theta} \right)^2 + r \frac{d^2 r}{d\theta^2} = 0$$



291. The radius of curvature of the curve $y=e^x$ at the point where it crosses the y -axis, is given by

$$(a) 4$$



$$(b) \sqrt{2}$$



$$(c) 2\sqrt{2}$$



$$(d) 2$$



292. The radius of curvature of the circle $x=a \cos \theta$, $y=a \sin \theta$ at any point is given by

$$(a) a$$



$$(b) a^2$$



$$(c) \sqrt{a}$$



$$(d) a^{3/2}$$



293. If x and y are functions of the arc s , then ρ is given by

$$(a) \frac{dy}{ds} \frac{d^2 x}{ds^2}$$



$$(b) \frac{dx}{ds} \frac{d^2 y}{ds^2}$$



$$(c) \frac{1}{\rho^2} = \left(\frac{d^2 x}{ds^2} \right)^2 + \left(\frac{d^2 y}{ds^2} \right)^2$$



$$(d) \text{All of the above}$$



294. When the X -axis or the Y -axis is not a tangent at the origin of the given curve, then for calculating radius of curvature at the origin of such curves, we make use of

$$(a) \text{Rolle's Theorem}$$



$$(b) \text{Maclaurin's series}$$



$$(c) \text{Taylor's development of a function with Lagrange's form of remainder}$$



$$(d) \text{Lagrange's mean value theorem}$$



295. The value of $\rho(0,0)$ for the curve $y=x+3x^2-x^3$ is given by



$$(a) \frac{1}{3\sqrt{2}}$$



297. A relation between which of the following is known as a tangential polar equation of the curve?

$$(a) p \text{ and } r$$



$$(b) r \text{ and } \psi$$



$$(c) p \text{ and } \psi$$



$$(d) p \text{ and } \theta$$



298. For the curve $r=f(\theta)$, the curvature at any point is given by

$$(a) p^2 u^3 \left(u + \frac{d^2 u}{d\theta^2} \right)$$



$$(b) \frac{p^2 u^3}{u + \frac{d^2 u}{d\theta^2}}$$



$$(c) \frac{\left[u^2 + \left(\frac{du}{d\theta} \right)^2 \right]^{3/2}}{u^3 \left(u + \frac{d^2 u}{d\theta^2} \right)}$$



$$(d) \text{None of the above}$$



299. The radius of curvature at the origin for the curve $r=a \sin n\theta$ is given by

$$(a) 2na$$



$$(b) \frac{na}{2}$$



$$(c) \frac{2n}{a}$$



$$(d) n^2 a^2$$



300. The radius of curvature at the origin for the cycloid

$x=a(\theta+\sin \theta)$, $y=a(1-\cos \theta)$ is given by

- (a) $4a$ ☐
 (b) $2a$ ☐
 (c) $2\sqrt{a}$ ☐
 (d) $4/a$ ☐

301. Which of the following formulae is incorrect?

For any curve

- (a) $\frac{r}{\rho} = \sin \phi \left(1 + \frac{d\phi}{d\theta} \right)$ ☐
 (b) $\frac{d^2r}{ds^2} = \frac{\sin \phi}{r} - \frac{\sin \phi}{\rho}$ ☐
 (c) $r \left(\frac{d\theta}{ds} \right)^2 - \frac{d^2r}{ds^2} = \frac{r}{\rho} \frac{d\theta}{ds}$ ☐
 (d) $\rho = r \frac{d\theta}{ds} \left[r \left(\frac{d\theta}{ds} \right)^2 - \frac{d^2r}{ds^2} \right]$ ☐

302. The radius of curvature at any point of the ellipse

$a^2 + b^2 - r^2 = \frac{a^2 b^2}{p^3}$ is given by

- (a) $\frac{a^2 b^2}{p^3}$ ☐
 (b) $\frac{ab}{p^2}$ ☐
 (c) $\frac{a^2 b^2}{p^2}$ ☐
 (d) $\frac{a^2 + b^2}{p^2}$ ☐

303. The radius of curvature at any point of the epicycloid $p=a \sin b\psi$ is given by

- (a) $p(b^2-1)$ ☐
 (b) $p(1-b^2)$ ☐
 (c) $p(1-a^2)$ ☐
 (d) $p(a^2-1)$ ☐

304. Chord of curvature through the pole for the curve $p=f(r)$ is given by

- (a) $2 \frac{f(r)}{f'(r)}$ ☐
 (b) $2\rho \frac{p}{r}$ ☐
 (c) Both of the above ☐

(d) None of the above ☐

305. Chord of curvature through the pole for the curve $r=f(\theta)$, is given by

- (a) $\frac{2r(r^2+r_1^2)}{r^2+2r_1^2-r_2^2}$ ☐
 (b) $\frac{2r(r^2+r_1^2)}{r^2+2r_1^2-r_2^2}$ ☐
 (c) $\frac{2r(r^2+r_1^2)}{r^2+r_1^2-r_2^2}$ ☐
 (d) None of the above ☐

306. The chord of curvature perpendicular to the radius vector is given by

- (a) $2\rho \sqrt{1-\sin^2 \phi}$ ☐
 (b) $\frac{2\rho}{r} \sqrt{r^2-p^2}$ ☐
 (c) Both of the above ☐
 (d) None of the above ☐

307. $x=(2n+1)\frac{\pi}{2}$, where n is any integer,

are the asymptotes of the curves

- (a) $y=\tan x$ and $y=\cot x$ ☐
 (b) $y=\tan x$ and $y=\sec x$ ☐
 (c) $y=\tan x$ and $y=\operatorname{cosec} x$ ☐
 (d) $y=\cot x$ and $y=\operatorname{cosec} x$ ☐

308. $x=n\pi$, where n is any integer, are the asymptotes of the curves

- (a) $y=\operatorname{cosec} x$ and $y=\tan x$ ☐
 (b) $y=\operatorname{cosec} x$ and $y=\sec x$ ☐
 (c) $y=\operatorname{cosec} x$ and $y=\cot x$ ☐
 (d) $y=\sec x$ and $y=\tan x$ ☐

309. In which of the following cases, there is no asymptote corresponding to the value of m obtained from $\phi_n(m)=0$?

- (a) $\phi_n'(m)=0$, $\phi_{n-1}(m)=0$ ☐
 (b) $\phi_n'(m)=0$, $\phi_{n-1}(m)\neq 0$ ☐
 (c) $\phi_n'(m)\neq 0$, $\phi_{n-1}(m)=0$ ☐
 (d) All of the above ☐

310. If $\phi_n'(m)=0=\phi_{n-1}(m)$, then corresponding to the same value of m we get

- (a) Two asymptotes ☐
 (b) Two asymptotes $\parallel$ to x -axis ☐
 (c) Two asymptotes $\parallel$ to y -axis ☐
 (d) Two parallel asymptotes ☐

311. The asymptotes of which of the following curves form a square ?

- (a) $(x^2+y^2)x-ay^2=0$ ☐
 (b) $x^2y^2-a^2(x^2+y^2)=0$ ☐
 (c) $y(x-y)^2=x+y$ ☐
 (d) $xy^2=(x+y)^2$ ☐

312. The curve $(x^2+y^2)x-ay^2=0$ has

- (a) Two asymptotes $\parallel$ to x -axis and one $\parallel$ to y -axis ☐
 (b) One asymptote $\parallel$ to x -axis and one $\parallel$ to y -axis ☐
 (c) One asymptote $\parallel$ to x -axis ☐
 (d) One asymptote $\parallel$ to y -axis ☐

313. An algebraic curve of n th degree has

- (a) Atmost n real asymptotes ☐
 (b) Atleast n real asymptotes ☐
 (c) $\frac{n}{2}$ real and $\frac{n}{2}$ imaginary asymptotes if n is even ☐
 (d) $\frac{n+1}{2}$ real and $\frac{n-1}{2}$ imaginary asymptotes if n is imaginary ☐

314. Which of the following statements is correct ?

An algebraic curve of an

- (a) Odd degree has atleast two imaginary asymptotes ☐
 (b) Odd degree has atleast two real asymptotes ☐
 (c) Even degree may or may not have real asymptotes ☐
 (d) Even degree has atleast one real asymptote ☐

315. The curve $x^3-y^3-x^2-5y^2-11x-5y+7=0$ has

- (a) One imaginary asymptote and two real ☐
 (b) No real and all imaginary ☐
 (c) Only one real asymptote ☐
 (d) Three real asymptotes ☐

316. The algebraic curve $x^3-2x^2y+xy^2+x^2-xy+2=0$

has—oblique asymptotes

- (a) No ☐

- (b) One ☐
 (c) Two ☐
 (d) Three ☐

317. The algebraic curve

$$x^2(x-y)^2+a^2(x^2-y^2)-a^2xy=0$$

has— asymptotes parallel to coordinate axis

- (a) Two ☐
 (b) Only one ☐
 (c) No ☐
 (d) Four ☐

318. None of the asymptotes of the curve

$$(x^2-y^2)(x+2y+1)+(x+y+1)=0$$

is given by

- (a) $x+y=0$ ☐
 (b) $x-y=0$ ☐
 (c) $x+2y+1=0$ ☐
 (d) $x+y+1=0$ ☐

319. The curve

$$x^2(x^2-y^2)(x-y)+2x^3(x-y)-4y^3=0$$

has— asymptotes corresponding to the repeated linear factor $(x-y)^2$ of the highest degree terms

- (a) No real ☐
 (b) One real ☐
 (c) Two real ☐
 (d) Imaginary ☐

320. What are asymptotes of

$$(x+2y-1)(x^2+y^2)-(3x+4y-5)=0$$

- (a) $x+2y-1=0$, $x=\pm y$ ☐
 (b) $x+2y-1=0$, $3x+4y=5$ ☐
 (c) $x+2y-1=0$ only ☐
 (d) $3x+4y-5=0$ only ☐

321. The asymptotes of a cubic which cut the curve in—points, lie on a—

- (a) 1, straight line ☐
 (b) 3, circle ☐
 (c) 6, parabola ☐
 (d) 3, straight line ☐

322. The asymptotes of the quartic

$$(x^2-4y^2)(x^2-9y^2)+5x^2y-5xy^2-30y^3+xy+7y^2-1=0$$

cut the curve in—points

- (a) Two ☐

- (b) Three ☐
 (c) Six ☐
 (d) Eight ☐

323. If the equation of the curve be of the type

$$y = mx + C + \frac{A}{x} + \frac{B}{x^2} + \frac{C}{x^3} + \dots$$

and $y = mx + C$, be its asymptote, then under what conditions, the curve does not lie above the asymptote?

- (a) $A > 0, x > 0$ ☐
 (b) $A < 0, x < 0$ ☐
 (c) $A = 0, B = 0, C > 0, x > 0$ ☐
 (d) $A > 0, x < 0$, ☐

324. If the equation of the curve be of the type

$$y = mx + C + \frac{A}{x} + \frac{B}{x^2} + \frac{C}{x^3} + \dots \text{and}$$

$y = mx + C$ be its asymptote, then under what conditions, the curve does not lie below the asymptote?

- (a) $A > 0, x < 0$ ☐
 (b) $A < 0, x > 0$ ☐
 (c) $A = 0, B > 0$ ☐
 (d) $A = 0, B = 0, C \neq 0, x < 0$ ☐

325. Let p be the perpendicular from the pole to the line and α be the angle which the perpendicular makes with the initial line. The asymptotes of the curve $r = f(\theta)$ are given by

- (a) $p = r \cos(\theta - \alpha)$ ☐
 (b) $p = r \sin(\theta - \alpha)$ ☐
 (c) $p = r \sin(\alpha - \theta)$ ☐
 (d) None of the above ☐

326. The asymptote of the curve $r\theta = a$ is

- (a) $r \sin \theta = a$ ☐
 (b) $r = a \sin \theta$ ☐
 (c) $r = a \cos \theta$ ☐
 (d) $r \cos \theta = a$ ☐

327. To calculate asymptotes of the curve $r = f(\theta)$, which of the following steps is required?

- (a) Change r to $\frac{1}{u}$ ☐
 (b) Find the values of θ for $u = 0$, say $\theta = \theta_1, \theta_2, \dots$ ☐

(c) Calculate $\frac{-du}{d\theta}$ when $u = 0$, and $\theta = \theta_1, \theta_2, \dots$ ☐

(d) All of the above ☐

328. How many asymptotes the curve

$$r = \frac{a}{1 - \cos \theta} \text{ has ?}$$

- (a) None ☐
 (b) One ☐
 (c) Two ☐
 (d) Infinite ☐

329. The curve $r^2 \theta = a^2$ has its asymptotes

as

- (a) $r = \pm a$ ☐
 (b) The initial line ☐
 (c) $r = 0$ ☐
 (d) None of the above ☐

330. The circular asymptotes of the curve $r = f(\theta)$ are given by

- (a) $r = \lim_{\theta \rightarrow 0} f(\theta)$ ☐
 (b) $r = \lim_{\theta \rightarrow \infty} f(\theta)$ ☐
 (c) $\theta = \lim_{r \rightarrow 0} f(r)$ ☐
 (d) $\theta = \lim_{r \rightarrow \infty} f(r)$ ☐

331. The circular asymptote of both the curves $r = a \frac{0}{\theta - 1}$ and $r = a \frac{e^\theta + 1}{e^\theta - 1}$ is

- (a) $r = 0$ ☐
 (b) $\theta = 0$ ☐
 (c) $r = a$ ☐
 (d) $\theta = (2n+1) \frac{\pi}{2}$, where n is any integer ☐

332. The curve traced below is represented by

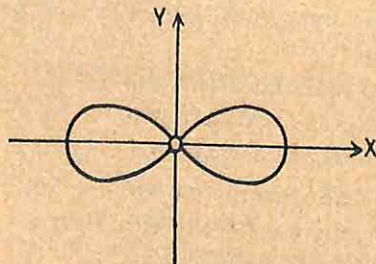


Fig. 3-12

(a) $y^2(x-a)=x^2(x+a)$ ☐

(b) $y^2x^2=x^2-a^2$ ☐

(c) $y^2(a^2+x^2)=x^2(a^2-x^2)$ ☐

(d) None of the above ☐

333. The curve traced below is represented by

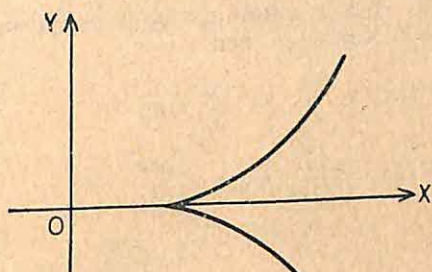


Fig. 3.13

(a) $y^2=(x-a)^4$ ☐

(b) $y^2=(x-a)^3$ ☐

(c) $y^2=(x-a)$ ☐

(d) $y^2=\frac{x^3}{a-x}$ ☐

334. The curve traced below is represented by

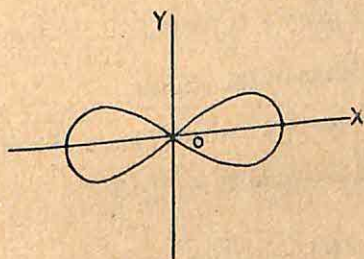


Fig. 3.14

(a) $(x^2+y^2)^3=axy^4$ ☐

(b) $a^4y^2=x^5(2a-x)$ ☐

(c) $a^2x^2=y^3(2a-y)$ ☐

(d) None of the above ☐

335. The curve traced below is represented by

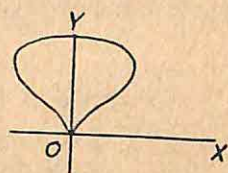


Fig. 3.15.

(a) $x^3-y^3=3axy$ ☐

(b) $x^3+y^3=3axy$ ☐

(c) $x^5+y^5=5ax^2y^2$ ☐

(d) $x^4+y^4=2a^2xy$ ☐

336. The curve traced below is represented by

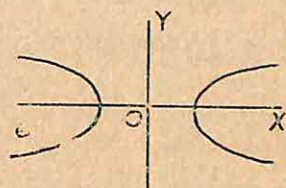


Fig. 3.16.

(a) $x^2y^2=a^2(x^2+y^2)$ ☐

(b) $y^2(x+2)=x+1$ ☐

(c) $y^2x^2=x^2-a^2$ ☐

(d) None of the above ☐

337. The curve traced below is represented by

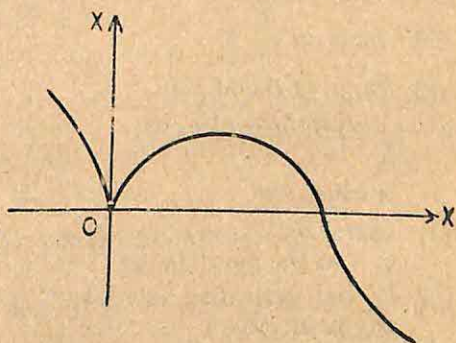


Fig. 3.17.

(a) $x^2y^2=(a+y)^2(a^2-y^2)$ ☐

(b) $y^2(x-a)=x^2(x+a)$ ☐

(c) $x^3+y^3=3ax^2$ ($a>0$) ☐

(d) None of the above ☐

338. The curve traced below is represented by

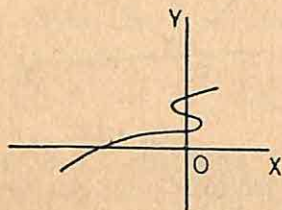


Fig. 3.18.

- (a) $x^2(y+1)=y^2(x-4)$ ☐
 (b) $y=(x-1)(x-2)(x-3)$ ☐
 (c) $x=(y-1)(y-2)(y-3)$ ☐
 (d) $x^2(x+y)-y^2=0$ ☐

339. The curve traced below is represented by

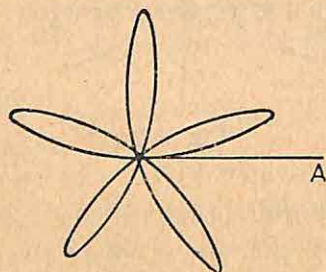


Fig. 3.19

- (a) $r=a \sin 5\theta$ ☐
 (b) $r=a \sin \theta$ ☐
 (c) $r=a \sin \frac{5}{2} \theta$ ☐
 (d) None of the above ☐

40. $\lim_{h \rightarrow 0} \frac{f(a+h, b) - f(a, b)}{h}$

is called the

- (a) Partial derivative of f with respect to x at the point (a, b) ☐
 (b) Partial derivative of f w.r.t. x at any point (x, y) ☐
 (c) Partial derivative of f w.r.t. y at the point (a, b) ☐
 (d) Partial derivative of f w.r.t. y at any point (x, y) ☐

341. $\frac{\partial z}{\partial x}$ at the point (a, b) is the tangent

of the angle which the tangent to the curve, in which the plane $z=f(a, b)$ cuts the surface at the point $P[a, b, f(a, b)]$, makes with X -axis

- (a) ZX ☐
 (b) $y=b$ parallel to the ZX plane ☐
 (c) $x=a$ parallel to the YZ plane ☐
 (d) YZ ☐

342. If z is a homogeneous function of x and y of degree n , then

(a) $x \frac{\partial z}{\partial x} + y \frac{\partial z}{\partial y} = nz$ ☐

(b) $x^2 \frac{\partial^2 z}{\partial x^2} + 2xy \frac{\partial^2 z}{\partial x \partial y} + y^2 \frac{\partial^2 z}{\partial y^2} = nz$ ☐

(c) $x^2 \frac{\partial^2 z}{\partial x^2} + 2xy \frac{\partial^2 z}{\partial x \partial y} + y^2 \frac{\partial^2 z}{\partial y^2} = n(n-1)z$ ☐

- (d) Both of the (a) and (c) above ☐

343. If $u=f\left(\frac{y}{x}\right)$, then

(a) $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = nu$ ☐

(b) $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = u$ ☐

(c) $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = 0$ ☐

- (d) None of the above ☐

344. If $u=f(r)$ where $r=\sqrt{x^2+y^2}$, then $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2}$ is equal to

(a) $f'(r) + \frac{1}{r} f''(r)$ ☐

(b) $f''(r) + r f'(r)$ ☐

(c) $f''(r) + \frac{1}{r} f'(r)$ ☐

- (d) None of the above ☐

345. If $z=f(x+ay)+\phi(x-ay)$, then

(a) $\frac{\partial^2 z}{\partial y^2} = a^2 \frac{\partial^2 z}{\partial x^2}$ ☐

$$(b) \frac{\partial^2 z}{\partial y^2} = a \frac{\partial^2 z}{\partial x^2}$$

$$(c) \frac{\partial^2 z}{\partial y^2} + a \frac{\partial^2 z}{\partial x^2} = 0$$

$$(d) \frac{\partial^2 z}{\partial x^2} + \frac{\partial^2 z}{\partial y^2} = 0$$

346. If $u=f(z)$, where z is a homogeneous function of x and y of degree n , then

$$(a) x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = nz$$

$$(b) x \frac{\partial z}{\partial x} + y \frac{\partial z}{\partial y} = nu$$

$$(c) x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = nz \frac{du}{dz}$$

$$(d) x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = z \frac{du}{dz}$$

347. If $u = \frac{x^2 y^2}{x+y}$,

then $x \frac{\partial^2 u}{\partial x^2} + y \frac{\partial^2 u}{\partial y^2}$ is equal to

$$(a) \frac{\partial u}{\partial x}$$

$$(b) 2 \frac{\partial u}{\partial x}$$

$$(c) 3 \frac{\partial u}{\partial x}$$

$$(d) 4 \frac{\partial u}{\partial x}$$

348. If $u = \tan^{-1} \frac{x^3 + y^3}{x-y}$, then

$x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y}$ is equal to

$$(a) 2z \text{ where } z = \frac{x^3 + y^3}{x-y}$$

$$(b) 2z \frac{du}{dz}$$

$$(c) 2 \sin u$$

$$(d) 2 \sin u \sec^2 u$$

349. If $z=f(x, y)$ be a function of x and y which possesses continuous partial derivatives w.r.t. x and y in the domain of definition of

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$$(a) \frac{\partial z}{\partial x} dx + \frac{\partial z}{\partial y} dy$$

$$(b) \frac{\partial z}{\partial y} dx + \frac{\partial z}{\partial x} dy$$

$$(c) \frac{\partial z}{\partial y} dx + \frac{\partial z}{\partial x} dy$$

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(a) Actual change dz in z corresponding to small changes δx and δy in x and y respectively

(b) Approximate change dz in z corresponding to small changes δx and δy in x and y respectively

(c) Approximate changes dx and dy in x and y respectively corresponding to small change δz in z

(d) Actual changes dx and dy in x and y respectively corresponding to small change δz in z

351. If an error of 1% is made in measuring the major and minor axes of an ellipse, then % of error in calculating its area is

(a) Also 1

(b) 2

(c) $\frac{1}{2}$

(d) None of the above

352. If an error of 2% is made in measuring the sides of a rectangle, then % of error in calculating its area is

(a) Also 2

(b) 1

(c) 4

(d) 8

353. The work that must be done to propel a ship of displacement D for a distance s in time t is proportional to $s^2 D^{2/3} t^2$. If the displacement is increased by 1% time is diminished by 1% and the distance by 3%, then approximate percentage increase of work necessary is

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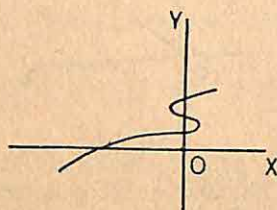


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 (b) $y=(x-1)(x-2)(x-3)$ ☐
 (c) $x=(y-1)(y-2)(y-3)$ ☐
 (d) $x^2(x+y)-y^2=0$ ☐

339. The curve traced below is represented by

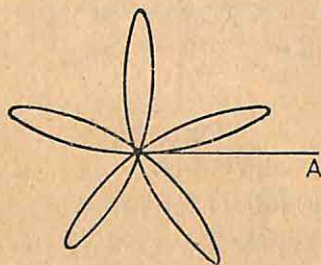


Fig. 3.19

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 (b) $r=a \sin \theta$ ☐
 (c) $r=a \sin \frac{5}{2} \theta$ ☐
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of the angle which the tangent to the curve, in which the plane $z=f(a, b)$ cuts the surface at the point $P[a, b, f(a, b)]$, makes with X -axis

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 (d) YZ ☐

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(b) $x^2 \frac{\partial^2 z}{\partial x^2} + 2xy \frac{\partial^2 z}{\partial x \partial y} + y^2 \frac{\partial^2 z}{\partial y^2} = nz$ ☐

(c) $x^2 \frac{\partial^2 z}{\partial x^2} + 2xy \frac{\partial^2 z}{\partial x \partial y} + y^2 \frac{\partial^2 z}{\partial y^2} = n(n-1)z$ ☐

(d) Both of the (a) and (c) above ☐

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(b) $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = u$ ☐

(c) $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = 0$ ☐

(d) None of the above ☐

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$$(a) x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = nz$$

$$(b) x \frac{\partial z}{\partial x} + y \frac{\partial z}{\partial y} = nu$$

$$(c) x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = nz \frac{du}{dz}$$

$$(d) x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = z \frac{du}{dz}$$

347. If $u = \frac{x^2 y^2}{x+y}$,

then $x \frac{\partial^2 u}{\partial x^2} + y \frac{\partial^2 u}{\partial y^2}$ is equal to

$$(a) \frac{\partial u}{\partial x}$$

$$(b) 2 \frac{\partial u}{\partial x}$$

$$(c) 3 \frac{\partial u}{\partial x}$$

$$(d) 4 \frac{\partial u}{\partial x}$$

348. If $u = \tan^{-1} \frac{x^3 + y^3}{x-y}$, then

$x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y}$ is equal to

$$(a) 2z \text{ where } z = \frac{x^3 + y^3}{x-y}$$

$$(b) 2z \frac{du}{dz}$$

$$(c) 2 \sin u$$

$$(d) 2 \sin u \sec^2 u$$

349. If $z=f(x, y)$ be a function of x and y which possesses continuous partial derivatives w.r.t. x and y in the domain of definition of

the function, then the total differential dz of z is given by

$$(a) \frac{\partial z}{\partial x} dx + \frac{\partial z}{\partial y} dy$$

$$(b) \frac{\partial z}{\partial y} dx + \frac{\partial z}{\partial x} dy$$

$$(c) \frac{\partial z}{\partial y} dx + \frac{\partial z}{\partial x} dy$$

$$(d) \frac{\partial z}{\partial x} dx + \frac{\partial z}{\partial y} dy$$

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(a) Actual change dz in z corresponding to small changes δx and δy in x and y respectively

(b) Approximate change dz in z corresponding to small changes δx and δy in x and y respectively

(c) Approximate changes dx and dy in x and y respectively corresponding to small change δz in z

(d) Actual changes dx and dy in x and y respectively corresponding to small change δz in z

351. If an error of 1% is made in measuring the major and minor axes of an ellipse, then % of error in calculating its area is

(a) Also 1

(b) 2

(c) $\frac{1}{2}$

(d) None of the above

352. If an error of 2% is made in measuring the sides of a rectangle, then % of error in calculating its area is

(a) Also 2

(b) 1

(c) 4

(d) 8

353. The work that must be done to propel a ship of displacement D for a distance s in time t is proportional to $s^2 D^{2/3} t^2$. If the displacement is increased by 1%, time is diminished by 1% and the distance by 3%, then approximate percentage increase of work necessary is

- (a) -3% ☐
 (b) 3% ☐
 (c) $-3\frac{1}{3}\%$ ☐
 (d) $3\frac{1}{3}\%$ ☐

354. If $z=f(x, y)$ be a function of x and y possessing continuous first order partial derivatives w.r.t. x and y and $x=\phi(u, v)$, $y=\psi(u, v)$ possess continuous first order partial derivatives, then $\frac{\partial z}{\partial v}$ is equal to

(a) $\frac{\partial z}{\partial x} \cdot \frac{dx}{dv} + \frac{\partial z}{\partial y} \cdot \frac{dy}{dv}$ ☐

- (b) $\frac{dz}{dx} \cdot \frac{\partial x}{\partial v} + \frac{dz}{dy} \cdot \frac{\partial y}{\partial v}$ ☐
 (c) $\frac{\partial z}{\partial x} \cdot \frac{\partial x}{\partial v} + \frac{\partial z}{\partial y} \cdot \frac{\partial y}{\partial v}$ ☐
 (d) None of the above ☐

355. The second order partial derivatives $\frac{\partial^2 z}{\partial x \partial y}$ and $\frac{\partial^2 z}{\partial y \partial x}$ of the function $z=f(x, y)$ are

- (a) Always equal ☐
 (b) Never equal ☐
 (c) Equal only when both of them are continuous ☐
 (d) None of the above ☐

ANSWERS

- | | | | | | |
|-------|-------|-------|--------|--------|--------|
| 1. d | 2. c | 3. d | 85. a | 86. a | 87. d |
| 4. b | 5. c | 6. b | 88. d | 89. b | 90. c |
| 7. d | 8. c | 9. c | 91. a | 92. a | 93. d |
| 10. a | 11. d | 12. a | 94. d | 95. c | 96. d |
| 13. d | 14. c | 15. b | 97. a | 98. b | 99. d |
| 16. d | 17. b | 18. c | 100. b | 101. b | 102. c |
| 19. d | 20. c | 21. d | 103. a | 104. b | 105. c |
| 22. c | 23. c | 24. a | 106. b | 107. c | 108. a |
| 25. c | 26. c | 27. b | 109. b | 110. d | 111. b |
| 28. d | 29. d | 30. a | 112. b | 113. b | 114. b |
| 31. c | 32. a | 33. b | 115. c | 116. d | 117. b |
| 34. a | 35. b | 36. c | 118. c | 119. d | 120. d |
| 37. a | 38. d | 39. c | 121. a | 122. c | 123. b |
| 40. b | 41. c | 42. a | 124. c | 125. c | 126. b |
| 43. d | 44. c | 45. d | 127. c | 128. c | 129. b |
| 46. a | 47. d | 48. b | 130. b | 131. d | 132. b |
| 49. b | 50. c | 51. b | 133. b | 134. b | 135. a |
| 52. b | 53. d | 54. a | 136. a | 137. c | 138. d |
| 55. a | 56. d | 57. c | 139. d | 140. c | 141. b |
| 58. c | 59. c | 60. a | 142. c | 143. d | 144. c |
| 61. b | 62. c | 63. a | 145. b | 146. a | 147. d |
| 64. d | 65. d | 66. d | 148. c | 149. c | 150. b |
| 67. a | 68. c | 69. b | 151. a | 152. c | 153. a |
| 70. c | 71. c | 72. d | 154. b | 155. b | 156. c |
| 73. c | 74. a | 75. d | 157. c | 158. a | 159. c |
| 76. a | 77. b | 78. b | 160. c | 161. a | 162. d |
| 79. c | 80. c | 81. a | 163. c | 164. d | 165. c |
| 82. a | 83. a | 84. c | 166. c | 167. a | 168. b |

169. <i>d</i>	170. <i>c</i>	171. <i>c</i>	265. <i>c</i>	266. <i>c</i>	267. <i>a</i>
172. <i>a</i>	173. <i>d</i>	174. <i>c</i>	268. <i>c</i>	269. <i>c</i>	270. <i>a</i>
175. <i>c</i>	176. <i>c</i>	177. <i>b</i>	271. <i>a</i>	272. <i>d</i>	273. <i>b</i>
178. <i>a</i>	179. <i>c</i>	180. <i>c</i>	274. <i>c</i>	275. <i>b</i>	276. <i>b</i>
181. <i>c</i>	182. <i>d</i>	183. <i>d</i>	277. <i>a</i>	278. <i>d</i>	279. <i>c</i>
184. <i>b</i>	185. <i>b</i>	186. <i>a</i>	280. <i>b</i>	281. <i>a</i>	282. <i>a</i>
187. <i>b</i>	188. <i>a</i>	189. <i>d</i>	283. <i>d</i>	284. <i>c</i>	285. <i>c</i>
190. <i>c</i>	191. <i>d</i>	192. <i>b</i>	286. <i>c</i>	287. <i>a</i>	288. <i>d</i>
193. <i>c</i>	194. <i>b</i>	195. <i>a</i>	289. <i>d</i>	290. <i>c</i>	291. <i>c</i>
196. <i>d</i>	197. <i>d</i>	198. <i>c</i>	292. <i>a</i>	293. <i>d</i>	294. <i>b</i>
199. <i>a</i>	200. <i>c</i>	201. <i>c</i>	295. <i>c</i>	296. <i>c</i>	297. <i>c</i>
202. <i>b</i>	203. <i>b</i>	204. <i>c</i>	298. <i>a</i>	299. <i>b</i>	300. <i>a</i>
205. <i>d</i>	206. <i>b</i>	207. <i>b</i>	301. <i>d</i>	302. <i>a</i>	303. <i>b</i>
208. <i>c</i>	209. <i>a</i>	210. <i>c</i>	304. <i>c</i>	305. <i>a</i>	306. <i>c</i>
211. <i>b</i>	212. <i>c</i>	213. <i>a</i>	307. <i>b</i>	308. <i>c</i>	309. <i>b</i>
214. <i>b</i>	215. <i>a</i>	216. <i>d</i>	310. <i>d</i>	311. <i>b</i>	312. <i>c</i>
217. <i>c</i>	218. <i>b</i>	219. <i>d</i>	313. <i>a</i>	314. <i>c</i>	315. <i>c</i>
220. <i>b</i>	221. <i>b</i>	222. <i>a</i>	316. <i>c</i>	317. <i>a</i>	318. <i>d</i>
223. <i>b</i>	224. <i>b</i>	225. <i>c</i>	319. <i>c</i>	320. <i>c</i>	321. <i>d</i>
226. <i>c</i>	227. <i>b</i>	228. <i>d</i>	322. <i>d</i>	323. <i>d</i>	324. <i>c</i>
229. <i>c</i>	230. <i>b</i>	231. <i>c</i>	325. <i>a</i>	326. <i>a</i>	327. <i>d</i>
232. <i>d</i>	233. <i>c</i>	234. <i>b</i>	328. <i>a</i>	329. <i>b</i>	330. <i>b</i>
235. <i>a</i>	236. <i>c</i>	237. <i>a</i>	331. <i>c</i>	332. <i>c</i>	333. <i>b</i>
238. <i>d</i>	239. <i>c</i>	240. <i>c</i>	334. <i>a</i>	335. <i>b</i>	336. <i>c</i>
241. <i>c</i>	242. <i>c</i>	243. <i>a</i>	337. <i>c</i>	338. <i>c</i>	339. <i>a</i>
244. <i>b</i>	245. <i>c</i>	246. <i>c</i>	340. <i>a</i>	341. <i>b</i>	342. <i>d</i>
247. <i>d</i>	248. <i>d</i>	249. <i>d</i>	343. <i>c</i>	344. <i>c</i>	345. <i>a</i>
250. <i>c</i>	251. <i>b</i>	252. <i>a</i>	346. <i>c</i>	347. <i>b</i>	348. <i>b</i>
253. <i>b</i>	254. <i>a</i>	255. <i>b</i>	349. <i>d</i>	350. <i>b</i>	351. <i>b</i>
256. <i>a</i>	257. <i>d</i>	258. <i>b</i>	352. <i>c</i>	353. <i>c</i>	354. <i>c</i>
259. <i>d</i>	260. <i>a</i>	261. <i>c</i>	355. <i>c</i>		
262. <i>d</i>	263. <i>a</i>	264. <i>c</i>			

Section—B

INTEGRAL CALCULUS

1. If $\frac{d[F(x)]}{dx} = f(x)$, then $\int f(x) dx$
 - (a) Has a unique value ☐
 - (b) Has atleast two values ☐
 - (c) Has a finite number of values only ☐
 - (d) Has an infinite number of values ☐
2. If $f(x)$ and $g(x)$ are functions of x such that $f(x) = g(x)$, then, in general,
 - (a) $\int f(x) dx = \int g(x) dx$ ☐
 - (b) $\int f(x) dx < \int g(x) dx$ ☐
 - (c) $\int f(x) dx > \int g(x) dx$ ☐
 - (d) $\int f(x) dx \neq \int g(x) dx$ ☐
3. The constant of integration
 - (a) Is always a real number ☐
 - (b) Is always a rational number ☐
 - (c) Is always imaginary ☐
 - (d) May be imaginary ☐
4. The two possible values $\frac{1}{2a} \log \frac{x-a}{x+a}$ and $\frac{1}{2a} \log \frac{a-x}{a+x}$ of the integral $\int \frac{dx}{x^2 - a^2}$ differ by
 - (a) $\frac{i\pi}{2a}$ ☐
 - (b) $\frac{\pi}{2a}$ ☐
 - (c) $\frac{i\pi}{4a}$ ☐
 - (d) None of the above ☐
5. If $x > a$, then $\int \frac{dx}{x^2 - a^2}$ is
 - (a) $\frac{1}{2a} \log \frac{x-a}{x+a}$ ☐
 - (b) $\frac{1}{2a} \log \frac{a-x}{a+x}$ ☐
 - (c) $-\frac{1}{a} \tanh^{-1} \frac{x}{a}$ ☐
 - (d) None of the above ☐
6. $\int_1^{\sqrt{3}} \frac{dx}{1+x^2}$ is equal to
 - (a) $\pi/4$ ☐
 - (b) $\pi/3$ ☐
 - (c) $\pi/12$ ☐
 - (d) $\pi/9$ ☐
7. $\int_2^3 \frac{2x dx}{x^2 + 1}$ is equal to
 - (a) $\log 3 - \log 2$ ☐
 - (b) $\log 2 - \log 3$ ☐
 - (c) $\log 3$ ☐
 - (d) $\log 2$ ☐
8. $\int_1^{\infty} \frac{dx}{x^3}$ is equal to
 - (a) $-1/2$ ☐
 - (b) 1 ☐
 - (c) $1/2$ ☐
 - (d) None of the above ☐
9. $\int_1^{\infty} \frac{dx}{\sqrt{x}}$ is equal to
 - (a) 2 ☐
 - (b) -2 ☐
 - (c) -1 ☐
 - (d) None of the above ☐

10. $\int u \frac{d^2v}{dx^2} dx$ is

(a) $u \frac{dv}{dx} - \int \frac{du}{dx} \frac{d^2v}{dx^2} dx$ ☐

(b) $u \frac{dv}{dx} + v \frac{du}{dx} - \int v \frac{d^2u}{dx^2} dx$ ☐

(c) $u \frac{dv}{dx} - v \frac{du}{dx} + \int v \frac{d^2u}{dx^2} dx$ ☐

(d) $u \frac{d^2v}{dx^2} - \int u \frac{d^3v}{dx^3} dx$ ☐

11. If $b^2 - 4ac > 0$ then $\int \frac{dx}{ax^2 + bx + c}$ is

(a) $\frac{2}{\sqrt{b^2 - 4ac}} \tan^{-1} \frac{2ax + b}{\sqrt{b^2 - 4ac}}$ ☐

(b) $\frac{1}{\sqrt{b^2 - 4ac}} \log \frac{2ax + b - \sqrt{b^2 - 4ac}}{2ax + b + \sqrt{b^2 - 4ac}}$ ☐

(c) $\frac{1}{\sqrt{b^2 - 4ac}} \tan^{-1} \frac{2ax + b}{\sqrt{b^2 - 4ac}}$ ☐

(d) $\frac{2}{\sqrt{b^2 - 4ac}} \log \frac{2ax + b - \sqrt{b^2 - 4ac}}{2bx + b + \sqrt{b^2 - 4ac}}$ ☐

12. $\int \frac{dx}{2x^2 + x + 1}$ is

(a) $\frac{2}{\sqrt{7}} \log \frac{4x + 1}{\sqrt{7}}$ ☐

(b) $\frac{2}{\sqrt{7}} \tan^{-1} \frac{4x + 1}{\sqrt{7}}$ ☐

(c) $\frac{2}{7} \tan^{-1} \frac{4x + 1}{7}$ ☐

(d) $\frac{2}{7} \log \frac{4x + 1}{7}$ ☐

13. If $a > 0$ and $b^2 - 4ac < 0$, then

$\int \frac{dx}{\sqrt{ax^2 + bx + c}}$ is

(a) $\frac{1}{\sqrt{a}} \cosh^{-1} \frac{2ax + b}{\sqrt{4ac - b^2}}$ ☐

(b) $\frac{1}{\sqrt{a}} \sinh^{-1} \frac{2ax + b}{\sqrt{4ac - b^2}}$ ☐

(c) $\frac{1}{\sqrt{a}} \sin^{-1} \frac{2ax + b}{\sqrt{4ac - b^2}}$ ☐

(d) $\frac{1}{\sqrt{a}} \cos^{-1} \frac{2ax + b}{\sqrt{4ac - b^2}}$ ☐

14. If $a > 0$ and $b^2 - 4ac < 0$, then

$\int \frac{dx}{\sqrt{ax^2 + bx + c}}$ is

(a) $\frac{1}{\sqrt{a}} \cosh^{-1} \frac{2ax + b}{\sqrt{b^2 - 4ac}}$ ☐

(b) $\frac{1}{\sqrt{a}} \sinh^{-1} \frac{2ax + b}{\sqrt{b^2 - 4ac}}$ ☐

(c) $\frac{1}{\sqrt{a}} \sin^{-1} \frac{2ax + b}{\sqrt{4ac - b^2}}$ ☐

(d) $\frac{1}{\sqrt{a}} \cos^{-1} \frac{2ax + b}{\sqrt{4ac - b^2}}$ ☐

15. Which of the following is an equivalent of $\int_a^b f(x) dx$?

(a) $\int_a^b F(x) dx$ ☐

(b) $-\int_a^b f(t) dt$ ☐

(c) $\int_b^a f(t) dt$ ☐

(d) $\int_a^b f(y) dy$ ☐

16. Which of the following is a correct property of definite integrals ?

(a) $\int_0^a f(x) dx = \int_0^a f(a-x) dx$ ☐

(b) $\int_{-a}^a f(x) dx = 0$ if $f(x)$ is an even function of x ☐

(c) $\int_{-a}^a f(x) dx = 2 \int_0^a f(x) dx$ ☐

(d) $\int_0^{2a} f(x) dx = 2 \int_0^a f(x) dx$ ☐

17. $\int_0^{\frac{\pi}{2}} \log \sin x dx$ is equal to

(a) $\frac{\pi}{4} \log 2$ ☐

(b) $-\frac{\pi}{2} \log 2$ ☐

- (c) $\frac{\pi}{2} \log 2$ ☐
- (d) None of the above ☐
18. $\int a^{px+q} dx$ is equal to ☐
- (a) $a^{px+q} \log a$ ☐
- (b) $\frac{a^{px+q}}{\log a}$ ☐
- (c) $\frac{a^{px+q}}{p \log a}$ ☐
- (d) $\frac{1}{p} a^{px+q} \log a$ ☐
19. $\int \frac{dx}{b^2 + a^2 x^2}$ is equal to ☐
- (a) $\frac{1}{b} \tan^{-1} \frac{x}{b}$ ☐
- (b) $\frac{1}{ab} \tan^{-1} \frac{a}{b} x$ ☐
- (c) $\frac{a}{b} \tan^{-1} \frac{b}{a} x$ ☐
- (d) $\frac{b}{a} \tan^{-1} \frac{a}{b} x$ ☐
20. $\int \tan x \, dx$ is equal to ☐
- (a) $\log \cos x$ ☐
- (b) $\log \sec x$ ☐
- (c) $-\log \sec x$ ☐
- (d) $\sec^2 x$ ☐
21. $\int \operatorname{cosec} x \, dx$ is equal to ☐
- (a) $\log \tan x$ ☐
- (b) $-\log \sin x$ ☐
- (c) $\log \tan \frac{x}{2}$ ☐
- (d) $\log \cot x$ ☐
22. $\int \sec x \, dx$ is equal to ☐
- (a) $\log \cos x$ ☐
- (b) $\sec x + \tan x$ ☐
- (c) $\log (\sec x + \tan x)$ ☐
- (d) None of the above ☐
23. $\int \sec x \, dx$ is equal to ☐
- (a) $\frac{1}{2} \log \frac{1 + \sin x}{1 - \sin x}$ ☐
- (b) $\log \frac{1 + \tan x/2}{1 - \tan x/2}$ ☐
- (c) $\log (\sec x + \tan x)$ ☐
- (d) All of the above ☐
24. $\int \operatorname{cosec} x \, dx$ is equal to ☐
- (a) $\log \tan x/2$ ☐
- (b) $\log (\operatorname{cosec} x - \cot x)$ ☐
- (c) $\frac{1}{2} \log \frac{1 - \cos x}{1 + \cos x}$ ☐
- (d) All of the above ☐
25. $\int \frac{dx}{\sqrt{x^2 + a^2}}$ is equal to ☐
- (a) $\log \frac{x + \sqrt{x^2 + a^2}}{a}$ ☐
- (b) $\log [x + \sqrt{x^2 + a^2}]$ ☐
- (c) Both of the above ☐
- (d) None of the above ☐
26. Which of the following is an integral of $\sqrt{a^2 - x^2}$ w.r.t. x ? ☐
- (a) $\frac{x}{2} \sqrt{a^2 - x^2} + \frac{a^2}{2} \sin^{-1} \frac{x}{a}$ ☐
- (b) $\frac{x}{2} \sqrt{x^2 + a^2} + \frac{a^2}{2} \sinh^{-1} \frac{x}{a}$ ☐
- (c) $\frac{x}{2} \sqrt{x^2 - a^2} - \frac{a^2}{2} \log [x + \sqrt{x^2 - a^2}]$ ☐
- (d) $\frac{x}{2} \sqrt{x^2 + a^2} + \frac{a^2}{2} \log [x + \sqrt{x^2 + a^2}]$ ☐
27. $\int x \log x \, dx$ is equal to ☐
- (a) $\frac{x^2}{2} \left(\log x - \frac{x^2}{4} \right)$ ☐
- (b) $\frac{x^2}{2} \log x - \frac{x^2}{4}$ ☐
- (c) $\frac{x}{2} \log x - \frac{x^2}{4}$ ☐
- (d) $\frac{x^2}{2} (\log x - 1)$ ☐
28. $\int \log x \, dx$ is equal to ☐
- (a) $x \log x - x$ ☐
- (b) $\log x - x$ ☐
- (c) $x(\log x - x)$ ☐
- (d) None of the above ☐
29. $\int \sin^{-1} x \, dx$ is equal to ☐
- (a) $\sin^{-1} x + \sqrt{1 - x^2}$ ☐

- (b) $x \sin^{-1} x + \frac{1}{\sqrt{1-x^2}}$ ☐ (b) $\frac{16}{35} \pi/2$ ☐
- (c) $\frac{\sin^{-1} x}{x} + \frac{1}{\sqrt{1-x^2}}$ ☐ (c) $\frac{8}{35} \pi/2$ ☐
- (d) None of the above ☐ (d) $\frac{16}{35}$ ☐
30. $\int_0^{\pi/2} \sin^n x dx$ is equal to
- (a) $\frac{n-1}{n} \cdot \frac{n-3}{n-2} \cdot \frac{n-5}{n-4} \cdots \frac{2}{3} \cdot 1$
if n is even ☐
- (b) $\frac{n-1}{n} \cdot \frac{n-3}{n-2} \cdot \frac{n-5}{n-4} \cdots \frac{1}{2} \cdot \frac{\pi}{2}$
if n is even ☐
- (c) $\frac{n-1}{n} \cdot \frac{n-3}{n-2} \cdot \frac{n-5}{n-4} \cdots \frac{2}{3} \cdot 1$,
where n is either odd or even ☐
- (d) $\frac{n-1}{n} \cdot \frac{n-3}{n-2} \cdot \frac{n-5}{n-4} \cdots \frac{1}{2} \cdot \frac{\pi}{2}$,
where n is either odd or even ☐
31. $\int_0^{\pi/2} \sin^n x dx$ and $\int_0^{\pi/2} \cos^n x dx$ are
- (a) Always equal ☐
- (b) Equal only in some particular cases ☐
- (c) Never equal ☐
- (d) Unequal only in some particular cases ☐
32. $\int_0^{\pi/2} \sin^{10} x dx$ is equal to
- (a) $\frac{63}{512}$ ☐
- (b) $\frac{21}{128} \pi$ ☐
- (c) $\frac{63}{256} \times \frac{\pi}{2}$ ☐
- (d) $\frac{63}{512} \times \frac{\pi}{2}$ ☐
33. $\int_0^{\pi/2} \sin^7 x dx$ is equal to
- (a) $\frac{8}{35}$ ☐
- (b) $\frac{16}{35} \pi/2$ ☐
- (c) $\frac{8}{35} \pi/2$ ☐
- (d) $\frac{16}{35}$ ☐
34. $\int_0^{\pi/4} 8 \cos^4 x \sin^4 x dx$ is equal to
- (a) $\frac{3\pi}{32}$ ☐
- (b) $\frac{\pi}{64}$ ☐
- (c) $\frac{3\pi}{64}$ ☐
- (d) $\frac{3}{64}$ ☐
35. $\int_0^{\pi/2} \sin^{2n} x dx$ is equal to
- (a) $\frac{|2n|}{(2^n \cdot |n|)^2}$ ☐
- (b) $\frac{|2n|}{2^{2n} (|n|)^2} \times \frac{\pi}{2}$ ☐
- (c) $\frac{|2n|}{2^n (|n|)^2}$ ☐
- (d) None of the above ☐
36. If $\phi_n = \int_0^{\pi/4} \tan^n x dx$, then $\phi_n + \phi_{n-2}$ is equal to
- (a) $\frac{1}{n}$ ☐
- (b) $\frac{1}{n-1}$ ☐
- (c) $\frac{n}{n-1}$ ☐
- (d) $\frac{n-1}{n}$ ☐
37. $\frac{1}{p+1}$ is equal to
- (a) $p \sqrt{p}$ ☐
- (b) $(p+1) \sqrt{p}$ ☐
- (c) $\frac{1}{p}$ ☐
- (d) None of the above ☐

38. $\left| \frac{1}{2} \right|$ is equal to

- (a) π ☐
 (b) $\sqrt{\pi}$ ☐
 (c) $\pi/2$ ☐
 (d) $2\sqrt{\pi}$ ☐

39. If n is a positive integer, then $\left| \overline{n+1} \right|$ is equal to

- (a) $\left| \overline{n+1} \right|$ ☐
 (b) $\left| \overline{n} \right|$ ☐
 (c) $\left| \overline{n-1} \right|$ ☐
 (d) None of the above ☐

40. Which of the following is wrong?

(a) $1.3.5 \dots (2p+2q-1)$

$$= \frac{2^{p+q}}{\sqrt{\pi}} \left| \frac{p+2q+1}{2} \right|$$
 ☐

(b) $1.3.5 \dots (2p-1)$

$$= \frac{2^p}{\sqrt{\pi}} \left| \frac{2p+1}{2} \right|$$
 ☐

(c) $2.4.6 \dots 2p = \frac{2^p}{\sqrt{\pi}} \left| \frac{2p+2}{2} \right|$ ☐

(d) $2.4.6 \dots (2p+2q)$

$$= \frac{2^{p+q}}{\sqrt{\pi}} \left| \frac{2p+2q+2}{2} \right|$$
 ☐

41. $\left| \overline{7} \right|$ is equal to

- (a) $720\sqrt{\pi}$ ☐
 (b) $120\sqrt{\pi}$ ☐
 (c) $\left| \overline{6} \right|$ ☐
 (d) $\left| \overline{7} \right|$ ☐

42. $\left| \frac{7}{2} \right|$ is equal to

- (a) $\frac{15}{8}$ ☐
 (b) $\frac{15}{4}$ ☐
 (c) $\frac{15}{4}\sqrt{\pi}$ ☐
 (d) None of the above ☐

43. $\int_0^{\pi/2} \sin^m x \cos^n x dx$

$$= \frac{\left| \frac{m+1}{2} \right| \left| \frac{n+1}{2} \right|}{2 \left| \frac{m+n+2}{2} \right|}, \text{ where}$$

- (a) m and n are both even positive integers only. ☐
 (b) m and n are both odd positive integers only. ☐
 (c) m is even and n is odd positive integer, Or m is odd and n is even positive integer. ☐
 (d) m and n are any positive integers. ☐

44. $\int_0^{\pi/2} \sin^6 \theta \cos^5 \theta d\theta$ is equal to

- (a) $\frac{48}{693}$ ☐
 (b) $\frac{8}{693}$ ☐
 (c) $\frac{48}{9009}\sqrt{\pi}$ ☐
 (d) $\frac{8}{693}\sqrt{\pi}$ ☐

45. $\int_0^{\pi/2} \sin^7 x \cos x dx$ is equal to

- (a) $\frac{\sin^8 1}{8}$ ☐
 (b) $1/8$ ☐
 (c) $\pi/16$ ☐
 (d) None of the above ☐

46. $\int_0^1 x^5 \sqrt{1-x^2} dx$ is equal to

- (a) $\frac{5\pi}{256}$ ☐
 (b) $\frac{3\pi}{32}$ ☐
 (c) $\frac{5\pi}{32}$ ☐
 (d) $\frac{3\pi}{256}$ ☐

47. $\int_0^1 x^m (1-x)^n dx$ is equal to

- (a) $\frac{|m| |n|}{|m+n+1|}$ ☐

(b) $\frac{\overline{m} \overline{n+1}}{\overline{m+n+2}}$ ☐

(c) $\frac{\overline{m+1} \overline{n+1}}{\overline{m+n+1}}$ ☐

(d) $\frac{\overline{m+1} \overline{n+1}}{\overline{m+n+2}}$ ☐

48. $\int_0^{\infty} e^{-x} x^n dx$ is equal to

(a) $\overline{n-1}$ ☐

(b) 0 ☐

(c) $\pi/2$ ☐

(d) $\overline{n}$ ☐

49. Mark the correct statement :—

$\int_{-a}^a f(x) dx$ is

(a) Always 0 ☐

(b) Always $2 \int_0^a f(x) dx$ ☐

(c) 0 if $f(x)$ is an odd function of x ☐

(d) 0 if $f(x)$ is an even function of x ☐

50. $\int_0^{2a} f(x) dx$ is equal to

$2 \int_0^a f(x) dx$ if

(a) $f(x)=f(2a-x)$ ☐

(b) $f(x)$ is an even function of x ☐

(c) $-f(x)=f(2a-x)$ ☐

(d) $f(x)$ is an odd function of x ☐

51. $\int_0^{\pi} \cos^m x \sin^n x dx$ is equal to zero,

if

(a) m is even ☐

(b) n is even ☐

(c) m is odd ☐

(d) n is odd ☐

52. $\int_0^{na} f(x) dx = n \int_0^a f(x) dx$ if

(a) $f(x)=f(a-x)$ ☐

(b) $f(x)=f(2a-x)$ ☐

(c) $f(x)=f(a+x)$ ☐

(d) $f(x)=f(2a+x)$ ☐

53. If $\phi(a-x)=\phi(x)$, then

$\int_0^a x\phi(x) dx$ is equal to

(a) $a \int_0^a \phi(x) dx$ ☐

(b) $x \int_0^a \phi(x) dx$ ☐

(c) $2a \int_0^{a/2} \phi(x) dx$ ☐

(d) $\frac{a}{2} \int_0^a \phi(x) dx$ ☐

54. $\int_0^{\pi/2} \log \sin x dx$ is equal to

(a) $\frac{\pi}{2} \log 2$ ☐

(b) $\pi \log 2$ ☐

(c) $\frac{\pi}{2} \log \frac{1}{2}$ ☐

(d) $-\frac{\pi}{2} \log \frac{1}{2}$ ☐

55. $\int_0^{\pi/2} \log \sec x dx$ is equal to

(a) $-\frac{\pi}{2} \log 2$ ☐

(b) $-\frac{\pi}{2} \log \frac{1}{2}$ ☐

(c) $\frac{\pi}{4} \log 2$ ☐

(d) $\frac{\pi}{2} \log \frac{1}{2}$ ☐

56. $\int_0^{\pi/2} \log \tan x dx$ is equal to

(a) $\frac{\pi}{2} \log 2$ ☐

(b) 0 ☐

(c) $\frac{\pi}{2} \log \frac{1}{2}$ ☐

(d) $-\frac{\pi}{2} \log \frac{1}{2}$ ☐

57. $\int_0^{\pi} \frac{x \sin x}{1+\cos^2 x} dx$ is equal to

(a) $\frac{\pi}{4}$ ☐

(b) $\frac{\pi^2}{4}$ ☐

(c) $-\frac{\pi^2}{4}$ ☐

(d) $\frac{\pi^2}{2}$ ☐

58. $\int_0^{\pi/2} \frac{\sqrt{\sin x}}{\sqrt{\sin x} + \sqrt{\cos x}} dx$ is equal to

(a) $\frac{\pi}{2}$ ☐

(b) $\frac{\pi}{4}$ ☐

(c) $\frac{\pi}{8}$ ☐

(d) $-\frac{\pi}{4}$ ☐

59. $\text{Lt}_{n \rightarrow \infty} \sum_{r=1}^{n-1} \frac{1}{\sqrt{n^2 - r^2}}$ is equal to

(a) 0 ☐

(b) $\frac{\pi}{2}$ ☐

(c) π ☐

(d) $\frac{\pi}{4}$ ☐

60. $\text{Lt}_{n \rightarrow \infty} \sum_{r=1}^n \frac{\sqrt{n}}{\sqrt{r(3\sqrt{r} + 4\sqrt{n})^2}}$

is equal to

(a) $\frac{3}{28}$ ☐

(b) $\frac{3}{14}$ ☐

(c) $\frac{1}{14}$ ☐

(d) None of the above ☐

61. $\text{Lt}_{n \rightarrow \infty} \sum_{r=1}^n \frac{2}{n} \cdot \frac{r}{n} \log \left\{ 1 + \left(\frac{r}{n} \right)^2 \right\}$

is equal to

(a) $\frac{1}{4} e$ ☐

(b) e^{-1} ☐

(c) $4e^{-1}$ ☐

(d) $\log \frac{4}{e}$ ☐

62. $\text{Lt}_{n \rightarrow \infty} \sum_{r=1}^n \left(\frac{1}{n+r} \right)$ is equal to

(a) 0 ☐

(b) $\log 2$ ☐

(c) $\log \frac{1}{2}$ ☐

(d) None of the above ☐

(3. $\text{Lt}_{n \rightarrow \infty} \sum_{r=1}^n \frac{n}{n^2 + r^2}$ is equal to

(a) $\frac{\pi}{4}$ ☐

(b) $\frac{\pi}{2}$ ☐

(c) π ☐

(d) $\frac{1}{4}$ ☐

64. $\text{Lt}_{n \rightarrow \infty} \sum_{r=1}^n \frac{r^2}{r^3 + n^3}$ is equal to

(a) $\log 2$ ☐

(b) $\frac{1}{2} \log 2$ ☐

(c) $\frac{1}{3} \log 2$ ☐

(d) $\frac{1}{4} \log 2$ ☐

65. $\text{Lt}_{n \rightarrow \infty} \sum_{r=1}^n \frac{r^3}{r^4 + n^4}$ is equal to

(a) $\frac{1}{4} \log 2$ ☐

(b) $\frac{1}{3} \log 2$ ☐

(c) $\frac{1}{2} \log 2$ ☐

(d) $\log 2$ ☐

66. $\lim_{n \rightarrow \infty} \left[\frac{1/n}{n^n} \right]^{1/n}$ is equal to

- (a) e ☐
 (b) $2e$ ☐
 (c) $\frac{1}{e}$ ☐
 (d) $\frac{3e}{4}$ ☐

67. $\lim_{n \rightarrow \infty} \left[\tan \frac{\pi}{2n} \cdot \tan \frac{2\pi}{2n} \cdots \cdots \tan \frac{n\pi}{2n} \right]^{1/n}$

is equal to

- (a) 0 ☐
 (b) 1 ☐
 (c) e ☐
 (d) e^{-1} ☐

68. If $f(x) = a + bx + cx^2$, then

$\int_0^1 f(x)$ is equal to

- (a) $\frac{1}{6} \left\{ f(0) + 4f\left(\frac{1}{2}\right) + f(1) \right\}$ ☐
 (b) $\frac{1}{3} \left\{ f(0) + 4f\left(\frac{1}{2}\right) + f(1) \right\}$ ☐
 (c) $f(0) + 4f\left(\frac{1}{2}\right) + f(1)$ ☐
 (d) None of the above ☐

69. In which of the following cases the integral is meaningless but the principal value of the integral exists?

- (a) $\int_0^1 \frac{dx}{1-x}$ ☐
 (b) $\int_0^1 \frac{dx}{x^3}$ ☐
 (c) $\int_{-1}^{+1} \frac{dx}{x^2}$ ☐
 (d) $\int_{-1}^2 \frac{dx}{x^3}$ ☐

70. In which of the following cases the integral is meaningless and also the principal value does not exist?

- (a) $\int_0^1 \frac{dx}{\sqrt{1-x}}$ ☐

(b) $\int_0^1 \frac{dx}{\sqrt{x}}$ ☐

(c) $\int_{-1}^1 \frac{dx}{x^2}$ ☐

(d) $\int_{-1}^1 \frac{dx}{x^{2/3}}$ ☐

71. Quadrature is the process of

(a) Determining the lengths of arcs of plane curves. ☐

(b) Determining the areas of plane regions ☐

(c) Derivation of intrinsic equations from the cartesian equations of curves ☐

(d) None of the above ☐

72. Rectification is the process of

(a) Evaluating the double integrals ☐

(b) Evaluating the multiple integrals ☐

(c) Determining the lengths of arcs of plane curves ☐

(d) Derivation of intrinsic equations from the cartesian equations of the curves. ☐

73. The area bounded by the curve $y=f(x)$, the axis of x , $x=a$ and $x=b$ is given by

(a) $\int_a^b f(y) dy$ ☐

(b) $\int_a^b y dx$ ☐

(c) $\int_a^b \sqrt{1 + \left(\frac{dy}{dx}\right)^2} dx$ ☐

(d) $\int_a^b \sqrt{1 + \left(\frac{dx}{dy}\right)^2} dx$ ☐

74. The area bounded by the curve $x=f(y)$, the axis of y , $y=a$ and $y=b$ is given by

(a) $\int_a^b f(x) dy$ ☐

(b) $\int_a^b \sqrt{1 + (f'(x))^2} dx$ ☐

(c) $\int_a^b x dy$ ☐

$$(d) \int_a^b \sqrt{1 + \left(\frac{dx}{dy}\right)^2} dy \quad \square$$

75. The area included between the cycloid $x=a(\theta - \sin \theta)$, $y=a(1 - \cos \theta)$ and its base is equal to

- (a) πa^2 ☐
 (b) $2\pi a^2$ ☐
 (c) $3\pi a^2$ ☐
 (d) $4\pi a^2$ ☐

76. By double integration method, the area bounded by the curve $y=f(x)$, the axis of x , $x=a$ and $x=b$, is given by

- (a) $\int_{y=a}^{y=b} \int_{x=a}^{x=b} y \, dx \, dy$ ☐
 (b) $\int_{x=a}^{x=b} \int_{y=0}^{f(x)} dx \, dy$ ☐
 (c) $\int_{x=a}^{x=b} \int_{y=a}^{y=b} dx \, dy$ ☐
 (d) $\int_{x=a}^{x=b} \int_{y=0}^{f(x)} y \, dx \, dy$ ☐

77. The area bounded by the curve $y=x^3$, the y -axis, the lines $y=1$ and $y=8$ is given by

- (a) 12 ☐
 (b) 6 ☐
 (c) $\frac{45}{4}$ ☐
 (d) 20 ☐

78. The area of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, is given by

- (a) ab ☐
 (b) $\frac{\pi}{2} ab$ ☐
 (c) πab ☐
 (d) None of the above ☐

79. The area bounded by the parabola $y^2=4cx$ and its latus rectum is given by

- (a) $\int_0^a y \, dx$ ☐
 (b) $2 \int_0^a 4ax \, dx$ ☐

$$(c) 2 \int_0^a \sqrt{4ax} \, dx \quad \square$$

$$(d) 2 \int_{-a}^a \sqrt{4ax} \, dx \quad \square$$

80. The area of the curve $a^2y=x^2(x+a)$ is equal to

$$(a) \int_0^a \frac{x^2}{a^2} (x+a) \, dx \quad \square$$

$$(b) \int_{-a}^0 \frac{x^2}{a^2} (x+a) \, dx \quad \square$$

$$(c) \int_{-a}^0 \frac{x}{a} \sqrt{x+a} \, dx \quad \square$$

$$(d) \text{None of the above} \quad \square$$

81. The area of a loop of the curve $x=a \sin 2t$, $y=a \sin t$ is given by

$$(a) \int_0^{\pi} a^2 \sin 2t \cos t \, dt \quad \square$$

$$(b) \int_0^a a \sin 2t \cos t \, dt \quad \square$$

$$(c) 2 \int_0^{\frac{\pi}{2}} a^2 \sin 2t \cos t \, dt \quad \square$$

$$(d) 2 \int_0^{\pi/2} 2a^2 \sin t \cos 2t \, dt \quad \square$$

82. The area bounded by the curve $y=c \cosh \frac{x}{c}$, the axis of x and the ordinates $x=0$ and $x=a$ is given by

$$(a) c \sinh \frac{x}{c} \quad \square$$

$$(b) c^2 \sinh \frac{x}{c} \quad \square$$

$$(c) c \sinh \frac{a}{c} \quad \square$$

$$(d) c^2 \sinh \frac{a}{c} \quad \square$$

83. The area between hyperbola $xy=c^2$, the axis of x and the lines $x=a$ and $x=b$ is given by

$$(a) c^2 \log \left(\frac{a}{b} \right) \text{ for all } a \text{ and } b \quad \square$$

$$(b) c^2 \log \left(\frac{a}{b} \right) \text{ for all } a > b \text{ and } a, b \text{ both positive} \quad \square$$

(c) $c^2 \log \frac{a}{b}$ for all $a > 0$ and $b < 0$ ☐

(d) $c^2 \log \frac{a}{b}$ for all $a < 0$ and $b > 0$ ☐

84. The area between the curve $y = 4 \sin x$ and the x -axis from $x = 0$ to $x = \pi$ is given by

- (a) 1 ☐
 (b) 2 ☐
 (c) 4 ☐
 (d) 8 ☐

85. The area enclosed by the curve $y = e^x$, x -axis, $x = -1$ and $x = 1$, is given by

- (a) $e + \frac{1}{e}$ ☐
 (b) $\frac{1 - e^2}{e}$ ☐
 (c) $\frac{e^2 - 1}{e}$ ☐
 (d) $\log \frac{1}{2}$ ☐

86. The area bounded by the curve $y^2 = x^3$ and the line $y = 2x$ is given by

- (a) $16/3$ ☐
 (b) $16/5$ ☐
 (c) $3/16$ ☐
 (d) $5/16$ ☐

87. The whole area of the curve $x = a \cos^3 t$, $y = b \sin^3 t$

is given by

- (a) $\pi/8 ab$ ☐
 (b) $\pi/4 ab$ ☐
 (c) $3\pi/8 ab$ ☐
 (d) $\pi/2 ab$ ☐

88. The common area between the curve $y^2 = 4ax$ and $x^2 = 4ay$ is given by

- (a) $a^2/3$ ☐
 (b) $4a^2/3$ ☐
 (c) $8a^2/3$ ☐
 (d) $16a^2/3$ ☐

89. The area of a segment cut off from a parabola $y^2 = 2x$ by the straight line $y = 4x - 1$ is given by

- (a) $9/32$ ☐
 (b) $9/16$ ☐
 (c) $9/64$ ☐
 (d) None of the above ☐

90. The area of the sector enclosed by the curve $r = f(\theta)$ and the two radii vectors $\theta = \alpha$ and $\theta = \beta$ is given by

- (a) $\int_{\alpha}^{\beta} r^2 d\theta$ ☐
 (b) $\frac{1}{2} \int_{\alpha}^{\beta} r^2 d\theta$ ☐
 (c) $\frac{1}{2} \int_{\alpha}^{\beta} r d\theta$ ☐
 (d) $\frac{1}{4} \int_{\alpha}^{\beta} r d\theta$ ☐

91. By double integration method, the area bounded by the curve $r = f(\theta)$ and radius vectors $\theta = \alpha$ and $\theta = \beta$ is given by

- (a) $\int_{\theta=\alpha}^{\theta=\beta} \int_{r=0}^{f(\theta)} dr d\theta$ ☐
 (b) $\int_{\theta=0}^{f(\theta)} \int_{r=\alpha}^{\beta} dr d\theta$ ☐
 (c) $\int_{\theta=\alpha}^{\beta} \int_{r=0}^{f(\theta)} r dr d\theta$ ☐
 (d) $\int_{\theta=\alpha}^{\theta=\beta} \int_{r=0}^{f(\theta)} r^2 d\theta dr$ ☐

92. The area of one loop of the curve $r = a \cos 4\theta$ is given by

- (a) $\frac{1}{2} \int_0^{\pi/4} a^2 \cos^2 4\theta d\theta$ ☐
 (b) $\frac{1}{2} \int_0^{\pi/8} a^2 \cos^2 4\theta d\theta$ ☐
 (c) $\frac{1}{2} \int_0^{\pi/2} a^2 \cos^2 4\theta d\theta$ ☐
 (d) None of the above ☐

93. The area of the cardioid $r = a(1 + \cos \theta)$ is given by

- (a) πa^2 ☐
 (b) $\frac{\pi}{2} a^2$ ☐
 (c) $\frac{3\pi}{2} a^2$ ☐
 (d) $2\pi a^2$ ☐

94. The area bounded by the curve $r=2a \sin \theta$, is given by

- (a) πa ☐
 (b) $\frac{1}{2}\pi a^2$ ☐
 (c) πa^2 ☐
 (d) $\frac{3}{2}\pi a^2$ ☐

95. The area enclosed by the curve $r^2=a^2 \sin \theta$ is given by

- (a) a^2 ☐
 (b) $2a^2$ ☐
 (c) $4a^2$ ☒
 (d) $2a$ ☐

96. The area of the loop of the given curve $r=a \sin 3\theta$ is given by

- (a) $\frac{\pi a^2}{3}$ ☐
 (b) $\frac{\pi a^2}{6}$ ☐
 (c) $\frac{\pi a^2}{9}$ ☐
 (d) $\frac{\pi a^2}{12}$ ☐

97. The area of the loop of the folium $x^3+y^3-3axy=0$, is given by

- (a) a^2 ☐
 (b) $\frac{1}{2}a^2$ ☐
 (c) $3/2 a^2$ ☐
 (d) $2a^2$ ☐

98. The area of the closed curve $x=a \cos t, y=b \sin t$ is given by

- (a) abt ☐
 (b) πab ☐
 (c) $\pi/2 ab$ ☐
 (d) $\pi/4 ab$ ☐

99. The area of the closed curve

$$x=a \cos \theta+b \sin \theta+c$$

$$y=a' \cos \theta+b' \sin \theta+c'$$

is equal to

- (a) $\pi(ab'-a'b)$ ☐
 (b) $\pi(bc'-c'b)$ ☐
 (c) $\pi(ac'-c'a)$ ☐
 (d) $\pi(aa'-bb')$ ☐

100. If A is the vertex, O the centre and $P(x, y)$ a point on the hyperbola

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1,$$

then x is equal to

- (a) $a \cosh \frac{2S}{ab}$ ☐
 (b) $b \cosh \frac{2S}{ab}$ ☐
 (c) $a \sinh \frac{2S}{ab}$ ☐
 (d) $b \sinh \frac{2S}{ab}$ ☐

101. The length of an arc of a given curve $y=f(x)$ measured from a fixed point A (whose abscissae is a) upto any point B (whose abscissae is b) on it is given by

- (a) $\sqrt{1+\left(\frac{dy}{dx}\right)^2}$ ☐
 (b) $\int_a^b \sqrt{1+\left(\frac{dy}{dx}\right)^2} dx$ ☐
 (c) $\int_a^b \left[1+\left(\frac{dy}{dx}\right)^2\right]^{3/2} dx$ ☐
 (d) None of the above ☐

102. The length of the arc of the curve $y=\log \sec x$ between the two points, whose abscissae are 0 and $\pi/3$ respectively, is given by

- (a) $\log (2+\sqrt{3})$ ☐
 (b) $\log \left(2+\frac{1}{\sqrt{3}}\right)$ ☐
 (c) $\log \left(\frac{1}{2}+\sqrt{3}\right)$ ☐
 (d) $\log \left(\frac{1}{2}+\frac{1}{\sqrt{3}}\right)$ ☐

103. The length of an arc of the curve $y=c \cosh \frac{x}{c}$ from the vertex to any point (x, y) is given by

- (a) $\frac{1}{c} \sinh x/c$ ☐
 (b) $c \sinh x/c$ ☐
 (c) $c \operatorname{cosech} x/c$ ☐

(d) $c \cosh x/c$ ☐104. For the catenary, $y=c \cosh x/c$, y^2 is equal to(a) $c^2 - s^2$ ☐(b) $c^2 + s^2$ ☐(c) $\sqrt{c^2 - s^2}$ ☐(d) $\sqrt{c^2 + s^2}$ ☐105. The length of the complete cycloid $x=a(\theta + \sin \theta)$, $y=a(1 - \cos \theta)$ is equal to(a) $2a$ ☐(b) $4a$ ☐(c) $8a$ ☐(d) $16a$ ☐106. The length of an arc of a cycloid $x=a(\theta + \sin \theta)$, $y=a(1 - \cos \theta)$ from the vertex to any point (x, y) is given by(a) $4a \sin \theta$ ☐(g) $4a \sin 2\theta$ ☐(c) $2y$ ☐(d) $\sqrt{8ay}$ ☐107. The entire length of the given curve $x=a \cos^3 \theta$, $y=a \sin^3 \theta$ is given by(a) $2a$ ☐(b) $4a$ ☐(c) $6a$ ☐(d) $12a$ ☐108. The entire length of the given curve $x^{2/3} + y^{2/3} = a^{2/3}$ is given by(a) $8a$ ☐(b) $6a$ ☐(c) $\sqrt{8ay}$ ☐(d) $4\sqrt{3a}$ ☐

109. The length of an arc of the given curve

$$x \sin \theta + y \cos \theta = f'(\theta)$$

$$x \cos \theta - y \sin \theta = f''(\theta)$$

is given by

(a) $f(\theta) + f'(\theta) + \text{constant}$ ☐(b) $f'(\theta) + f''(\theta) + \text{constant}$ ☐(c) $f(\theta) + f''(\theta) + \text{constant}$ ☐(d) None of the above ☐110. The length of an arc of the given curve $r=f(\theta)$ between the points for which $\theta=\alpha$ and $\theta=\beta$ respectively, is given by

(a) $\int_{\alpha}^{\beta} \sqrt{r^2 + \left(\frac{dr}{d\theta}\right)^2} d\theta$ ☐

(b) $\int_{\alpha}^{\beta} \sqrt{1 + r^2 \left(\frac{d\theta}{dr}\right)^2} dr$ ☐

(c) $\int_{\alpha}^{\beta} \left[r^2 + \left(\frac{dr}{d\theta}\right)^2 \right] d\theta$ ☐

(d) $\int_{\alpha}^{\beta} \left[1 + r^2 \left(\frac{d\theta}{dr}\right)^2 \right] dr$ ☐

111. The length of the arc of the given curve $\theta=f(r)$ between the points where $r=a$ and $r=b$, is given by

(a) $\int_a^b \sqrt{r^2 + \left(\frac{dr}{d\theta}\right)^2} dr$ ☐

(b) $\int_a^b \sqrt{\frac{1}{r^2} + \left(\frac{d\theta}{dr}\right)^2} dr$ ☐

(c) $\int_a^b \sqrt{1 + r^2 \left(\frac{d\theta}{dr}\right)^2} dr$ ☐

(d) $\int_a^b \sqrt{1 + r \left(\frac{d\theta}{dr}\right)^2} dr$ ☐

112. The length of the arc of the curve $r=ae^{\theta} \cot \alpha$ between the points for which the radii vectors are r_1 and r_2 respectively, is given by(a) $\sec \alpha$ ☐(b) $\sec \alpha(r_1 - r_2)$ ☐(c) $\sec \alpha(r_2 - r_1)$ ☐(d) $\cos \alpha(r_2 - r_1)$ ☐113. The perimeters of the cardioids $r=a(1 - \cos \theta)$ and $r=a(1 + \cos \theta)$ (a) Differ by $8a$ ☐(b) Differ by $4a$ ☐(c) Differ by $2a$ ☐(d) Are equal ☐114. The length of the arc of the curve $p=f(r)$ between the points where $r=a$ and $r=b$ respectively, is given by

(a) $\int_a^b r \sqrt{r^2 - p^2} dr$ ☐

(b) $\int_a^b r \sqrt{p^2 - r^2} dr$ ☐

$$(c) \int_a^b \frac{r}{\sqrt{r^2 - p^2}} dr$$

□

$$(d) \int_a^b \frac{1}{r} \sqrt{r^2 - p^2} dr$$

□

115. The length of an arc of the curve $p^2(a^4 + r^4) - a^4 r^2 = 0$ between the points for which $r=a$ and $r=b$, is equal to

$$(a) \int_a^b \sqrt{1 + \frac{a^4}{x^4}} dx$$

□

(b) The length of an arc of the hyperbola between the limits $x=a$ and $x=b$

□

(c) Both of the above

□

(d) None of the above

□

116. The intrinsic equation of a parabola $y^2 = 4ax$ (origin being the fixed point) is

$$(a) s = a \tan \psi \sec \psi + \log (\tan \psi + \sec \psi)$$

□

$$(b) s = a (\tan \psi + \sec \psi)$$

$$+ \log (\tan \psi + \sec \psi)$$

□

$$(c) s = a [\tan \psi \sec \psi + \log$$

$$(\tan \psi + \sec \psi)]$$

□

$$(d) s = a [\tan \psi \sec \psi + \log$$

$$(\tan \psi \sec \psi)]$$

□

117. The intrinsic equation of a semi cubical parabola $ay^2 = x^3$ (cusp being the fixed point) is given by

$$(a) s = \frac{8a}{3} (\sec^3 \psi - 1)$$

□

$$(b) s = \frac{8a}{27} \sec^3 \psi$$

□

$$(c) s = \left(\frac{2a}{3} \sec \psi \right)^3 - 1$$

□

$$(d) s = \frac{8a}{27} (\sec^3 \psi - 1)$$

□

118. The intrinsic equation of the cycloid $x = a(t + \sin t)$ and $y = a(1 - \cos t)$ is given by

$$(a) s = a \operatorname{cosec} \psi$$

□

$$(b) s = 4a \operatorname{cosec} \psi$$

□

$$(c) s = a \sin \psi$$

□

$$(d) s = 4a \sin \psi$$

□

119. By taking $(a, 0)$ as the fixed point, the intrinsic equation of the astroid

$$x^{2/3} + y^{2/3} = a^{2/3}$$

is given by

$$(a) s = \frac{3a}{2} \sin \psi$$

□

$$(b) s = 3a \sin^2 \psi$$

□

$$(c) s = \frac{3a}{2} \sin^2 \psi$$

□

$$(d) s = \frac{3a}{2} \operatorname{cosec}^2 \psi$$

□

120. The intrinsic equations of the cardioids $r = a(1 - \cos \theta)$ and $r = a(1 + \cos \theta)$ measured from the pole are

(a) Same

□

$$(b) s = 8a \sin^2 \frac{\psi}{6} \text{ and } s = 4a \sin \frac{\psi}{3}$$

respectively

□

$$(c) s = 8a \sin \frac{\psi}{6} \text{ and } s = 4a \sin \frac{\psi}{3}$$

respectively

□

$$(d) s = 8a \sin^2 \frac{\psi}{6} \text{ and } s = 4a \sin^2 \frac{\psi}{3}$$

respectively

□

121. The intrinsic equation of the curve $p = r \sin \alpha$ is given by

$$(a) s = ce^{\psi} \tan \alpha$$

□

$$(b) s = ce^{\psi} \cot \alpha$$

□

$$(c) s = ce^{\psi} \sin \alpha$$

□

$$(d) s = ce^{\psi} \operatorname{cosec} \alpha$$

□

c being the constant

122. The volume of the solid generated by the revolution about the x -axis, of the area bounded by the curve $y = f(x)$, x -axis and the lines $x = a$ and $x = b$, is given by

$$(a) \int_a^b \frac{\pi}{2} y^2 dx$$

□

$$(b) \int_a^b \pi y dx$$

□

$$(c) \int_a^b \pi y^2 dx$$

□

$$(d) \int_a^b \pi y^3 dx$$

□

123. Let $P(x, y)$ be any point on the curve $y=f(x)$, $Q(x+\delta x, y+\delta y)$ be a point on the curve very near to P and δv be the volume obtained by revolving the arc PQ about x -axis. Then

(a) $\lim_{\delta x \rightarrow 0} \frac{\delta v}{\delta x} = \int_a^b \pi y^2 dx$ ☐

(b) $\frac{dv}{dx} = \pi y^2 dx$ ☐

(c) $\lim_{\delta x \rightarrow 0} \frac{\delta v}{\delta x} = \pi y^2$ ☐

(d) $\lim_{\delta x \rightarrow 0} \frac{\delta v}{\delta x} = \int_a^b \pi x^2 dy$ ☐

124. The volume of the solid obtained by revolution of an ellipse

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

about its minor axis is given by

(a) $2 \int_0^a \pi y^2 dx$ ☐

(b) $\int_0^a \pi y^2 dx$ ☐

(c) $2 \int_0^b \pi x^2 dy$ ☐

(d) $\int_0^b \pi x^2 dy$ ☐

125. The volume of the reel generated by revolving the part of the parabola $y^2=4ax$ cut off by the latus rectum about the tangent at the vertex is given by

(a) $\int_0^{2a} \pi x^2 dy$ ☐

(b) $2 \int_0^{2a} \pi x^2 dy$ ☐

(c) $\int_0^a \pi y^2 dx$ ☐

(d) $2 \int_0^a \pi y^2 dx$ ☐

126. The volume of the solid generated by the revolution of the curve $x=a \cos^3 t$, $y=a \sin^3 t$ about the x -axis is given by

(a) $\frac{32\pi a^3}{35}$ ☐

(b) $\frac{16\pi a^3}{105}$ ☐

(c) $\frac{32\pi a^2}{105}$ ☐

(d) $\frac{32\pi a^3}{105}$ ☐

127. The volume of the solid formed by the revolution of $x=a(\theta-\sin\theta)$, $y=a(1-\cos\theta)$ about its base is given by

(a) $5\pi a^3$ ☐

(b) $10\pi^2 a^2$ ☐

(c) $5\pi^2 a^3$ ☐

(d) $5\pi^3 a^2$ ☐

128. The volume of the solid generated by the revolution about the initial line of the area bounded by the curve $r=f(\theta)$ and the radii vectors $\theta=\alpha$, $\theta=\beta$ is given by

(a) $2\pi \int_{\alpha}^{\beta} r^3 \sin^3 \theta d\theta$ ☐

(b) $\frac{2\pi}{3} \int_{\alpha}^{\beta} r^2 \sin^2 \theta d\theta$ ☐

(c) $\frac{2\pi}{3} \int_{\alpha}^{\beta} r \sin \theta d\theta$ ☐

(d) $\frac{2\pi}{3} \int_{\alpha}^{\beta} r^3 \sin \theta d\theta$ ☐

129. The volume of the solid generated by the revolution of the cardioid $r=a(1+\cos\theta)$ about the initial line is given by

(a) $8\pi a^3$ ☐

(b) $4\pi a^3$ ☐

(c) $\frac{8}{3}\pi a^3$ ☐

(d) $2\pi a^3$ ☐

130. The volume of the solid formed by revolving the cardioid $r=a(1-\cos\theta)$ about the initial line is given by

(a) $8\pi a^3$ ☐

(b) $4\pi a^3$ ☐

(c) $\frac{8}{3}\pi a^3$ ☐

(d) $2\pi a^3$ ☐

131. The volume of the solid generated by the revolution of $r=2a \cos \theta$ about the initial line is given by

(a) $\frac{4}{3}\pi a^2$ ☐

(b) $2\pi a$ ☐

(c) $\frac{4}{3}\pi a^3$ ☐

(d) πa^2 ☐

132. The surface area of the segment of a sphere of radius a and height h is given by

(a) $2\pi h$ ☐

(b) $2\pi a^2 h$ ☐

(c) $2\pi ah$ ☐

(d) $\pi a^2 h$ ☐

133. Let s be the length of the arc of the curve measured from a fixed point on it to any point (x, y) . Then the curved surface of the solid generated by the revolution of the area bounded by the curve $y=f(x)$, the x -axis and the lines $x=a$, $x=b$ about the x -axis is given by

(a) $\int_{y=a}^b 2\pi x ds$ ☐

(b) $\int_{y=a}^b \pi x ds$ ☐

(c) $\int_{x=a}^b 2\pi y ds$ ☐

(d) $\int_{x=a}^b \pi y ds$ ☐

134. The surface area of the solid generated by the revolution of the curve $x=a \cos^3 t$, $y=a \sin^3 t$ about the x -axis is given by

(a) $12\pi a^2 \int_0^{\pi/2} \sin^6 t \cos t dt$ ☐

(b) $6\pi a^2 \int_0^{\pi/2} \cos^4 t \sin t dt$ ☐

(c) $12\pi a^2 \int_0^{\pi/2} \sin^4 t \cos t dt$ ☐

(d) $12\pi a^2 \int_0^{\pi/2} \sin^5 t dt$ ☐

135. The surface area of the solid formed by the revolution of the loop of the curve

$$x=t^2, y=t-\frac{t^3}{3}$$

is given by

(a) $\int_{t=0}^3 2\pi y ds$ ☐

(b) $\int_{t=0}^{\sqrt{3}} 2\pi y ds$ ☐

(c) $\int_{s=0}^{\sqrt{3}} 2\pi y ds$ ☐

(d) $\int_{s=0}^3 2\pi y ds$ ☐

136. The surface of the solid generated by the revolution of the cycloid

$$x=a(\theta-\sin \theta), y=a(1-\cos \theta)$$

about the x -axis, is given by

(a) The surface area of the solid generated by the revolution of the cycloid $x=a(\theta+\sin \theta)$, $y=a(1+\cos \theta)$ about its base ☐

(b) $\frac{64}{3}\pi a^2$ ☐

(c) Both of (a) and (b) ☐

(d) $\frac{32}{3}\pi a^2$ ☐

137. The area of the surface of the solid generated by the revolution of the cardioid $r=a(1+\cos \theta)$ about the initial line is given by

(a) $\frac{16}{5}\pi a^2$ ☐

(b) $\frac{32}{5}\pi a^2$ ☐

(c) $\frac{32}{3}\pi a^2$ ☐

(d) None of the above ☐

138. The surface area of the solid formed by the revolution of the curve $r=2a \cos \theta$ about the initial line is given by

(a) πa^2 ☐

(b) $4\pi a^2$ ☐

(c) $2\pi a$ ☐

(d) $\frac{4}{3}\pi a^3$ ☐

139. The surface area of the solid generated by the revolution of the curve $r^2=a^2 \cos 2\theta$ about the initial line is given by

- (a) The surface area of the solid generated by revolving the curve about the tangent at the pole. ☐

(b) $4\pi \int_{\theta=0}^{\pi/4} r \sin \theta \, ds$ ☐

- (c) Both of the above ☐

- (d) None of the above ☐

140. The volume of the solid generated by revolving the area enclosed between the curve $y^2 = x^3 + 5x$ and the lines $x=2$, $x=4$ about the x -axis is given by

(a) 18π ☐

(b) 90π ☐

(c) 118π ☐

(d) 180π ☐

141. If A is a region bounded by the curves $y=f_1(x)$, $y=f_2(x)$, $x=a$ and $x=b$, then

$$\iint_A f(x, y) \, dA$$

is equal to

(a) $\int_a^b \int_{f_1(x)}^{f_2(x)} f(x, y) \, dy \, dx$ ☐

(b) $\int_a^b \int_{f_1(x)}^{f_2(x)} f(x, y) \, dx \, dy$ ☐

(c) $\int_a^b dx \int_{f_1(x)}^{f_2(x)} f(x, y) \, dy$ ☐

- (d) Any of the above ☐

142. $\int_0^3 \int_1^2 (xy)(1+x+y) \, dx \, dy$ is given by

(a) $\int_0^3 \left(\frac{23}{6}x + \frac{3}{2}x^2 \right) dx$ ☐

(b) $\int_1^2 \left(\frac{27}{2}y + \frac{9}{2}y^2 \right) dy$ ☐

- (c) Any of the above ☐

- (d) (a) only ☐

143. $\iint xy \, dx \, dy$ over the region in the first quadrant for which $x+y \leq 1$, is given by

(a) $\int_{x=0}^1 \int_{y=0}^{1-x} xy \, dx \, dy$ ☐

(b) $\int_{y=0}^1 \int_{x=0}^{1-y} xy \, dx \, dy$ ☐

- (c) Any of the above ☐

- (d) None of the above ☐

144. $\int_0^{\pi/2} \int_0^{\sin \theta} r \, d\theta \, dr$ is given by

(a) $\int_0^{\pi/2} \frac{\sin^2 \theta}{2} d\theta$ ☐

(b) $\int_0^{\sin \theta} \frac{\pi}{2} r \, dr$ ☐

(c) $\int_0^{\pi/2} (1 - \cos 2\theta) d\theta$ ☐

- (d) None of the above ☐

145. The area between the parabolas $y^2 = 4ax$ and $x^2 = 4ay$ is given by

(a) $\int_{x=0}^{4a} \int_{y=0}^{2\sqrt{ax}} dx \, dy$ ☐

(b) $\int_{x=0}^{4a} \int_{y=x^2/4a}^{2\sqrt{ax}} dx \, dy$ ☐

(c) $\int_{y=0}^{4a} \int_{x=0}^{2\sqrt{ay}} dx \, dy$ ☐

- (d) None of the above ☐

146. The area of the region enclosed by the curves $x^2 + y^2 = a^2$ and $x+y=a$ in the first quadrant is given by

(a) $\int_{x=0}^a \int_{y=0}^{a-x} dx \, dy$ ☐

(b) $\int_{x=0}^a \int_{y=0}^{\sqrt{a^2-x^2}} dx \, dy$ ☐

(c) $\int_{x=0}^a \int_{y=a-x}^{\sqrt{a^2-x^2}} dx \, dy$ ☐

(d) $\int_{y=0}^a \int_{x=a-y}^{\sqrt{a^2-y^2}} dx \, dy$ ☐

147. The area of the region enclosed by the curve $y(x^2+2)=3x$ and $4y=x^2$ is given by

(a) $\int_0^2 \int_{y=0}^{x^2/4} dx \, dy$ ☐

(b) $\int_0^2 \int_{y=0}^{3x/(x^2+2)} dx \, dy$ ☐

(c) $\int_0^1 \int_{y=x^2/4}^{3x/(x^2+2)} dx \, dy$ ☐

(d) $\int_0^2 \int_{y=x^2/4}^{3x/(x^2+2)} dx \, dy$ ☐

148. The area of the cardioid

$r = a(1 + \cos \theta)$ is given by

(a) $2 \int_{\theta=0}^{\pi} \int_{r=0}^{a(1+\cos \theta)} r \, dr \, d\theta$ ☐

(b) $2 \int_{\theta=0}^{\pi/2} \int_{r=0}^{a(1+\cos \theta)} r \, dr \, d\theta$ ☐

(c) $2 \int_{\theta=0}^{\pi/6} \int_{r=0}^{a(1+\cos \theta)} r \, dr \, d\theta$ ☐

(d) $2 \int_{\theta=0}^{\pi/4} \int_{r=0}^{a(1+\cos \theta)} r \, dr \, d\theta$ ☐

149. The area of the curve $r = 2a \cos \theta$ is given by ☐

(a) $2 \int_0^{\pi/2} \int_0^{2a \cos \theta} r \, d\theta \, dr$ ☐

(b) $2 \int_0^{\pi} \int_0^{2a \cos \theta} r \, d\theta \, dr$ ☐

(c) $2 \int_0^{\pi/4} \int_0^r r \, d\theta \, dr$ ☐

(d) $2 \int_0^{2\pi} \int_0^r r \, d\theta \, dr$ ☐

50. The area of the lemniscate

$r^2 = a^2 \cos 2\theta$ is given by

(a) $2 \int_0^{\pi/4} \int_0^{a\sqrt{\cos 2\theta}} r \, d\theta \, dr$ ☐

(b) $4 \int_0^{\pi/4} \int_0^{a\sqrt{\cos 2\theta}} r \, d\theta \, dr$ ☐

(c) $2 \int_0^{\pi/2} \int_0^{a\sqrt{\cos 2\theta}} r \, d\theta \, dr$ ☐

(d) $2 \int_0^{\pi} \int_0^{a\sqrt{\cos 2\theta}} r \, d\theta \, dr$ ☐

ANSWERS

1. d	2. d	3. d	76. b	77. c	78. c
4. a	5. a	6. c	79. c	80. b	81. c
7. d	8. c	9. d	82. d	83. b	84. d
10. c	11. b	12. b	85. c	86. b	87. c
13. b	14. a	15. d	88. d	89. a	90. b
16. a	17. b	18. c	91. c	92. d	93. c
19. b	20. b	21. c	94. c	95. b	96. d
22. c	23. d	24. d	97. c	98. b	99. a
25. c	26. a	27. b	100. a	101. b	102. a
28. a	29. d	30. b	103. b	104. b	105. c
31. a	32. c	33. a	106. d	107. c	108. b
34. c	35. b	36. b	109. c	110. a	111. c
37. a	38. b	39. b	112. c	113. d	114. c
40. c	41. c	42. d	115. c	116. c	117. d
43. d	44. b	45. b	118. d	119. c	120. b
46. a	47. d	48. d	121. b	122. c	123. c
49. c	50. a	51. c	124. c	125. b	126. d
52. c	53. d	54. c	127. c	128. d	129. c
55. b	56. b	57. b	130. c	131. c	132. c
58. b	59. b	60. c	133. c	134. c	135. b
61. c	62. b	63. a	136. c	137. b	138. b
64. c	65. a	66. c	139. b	140. b	141. d
67. b	68. a	69. d	142. c	143. a	144. a
70. c	71. b	72. c	145. b	146. c	147. d
73. b	74. c	75. c	148. a	149. a	150. b

Section—C

CONVERGENCY AND DIVERGENCY OF AN INFINITE SERIES

1. Which of the following statements is correct ?

- (a) An infinite series $\sum u_n$ is said to converge if the sequence $\langle S_n \rangle$ of its partial sums converges ☐
- (b) If the sequence $\langle S_n \rangle$ of the partial sums of the series $\sum u_n$ converges to S , then S is said to be the sum of the series ☐
- (c) The convergence of a series is affected by the addition or omission of a finite number of terms of the series ☐
- (d) The convergence of a series is not affected by multiplying all of its terms by a fixed nonzero number ☐

2. Which one of the following statements is incorrect ?

- (a) A necessary and sufficient condition for a series $\sum u_n$ to converge is that to each $\epsilon > 0$ $\exists$ a positive integer m such that
 $|u_{m+1} + u_{m+2} + \dots + u_n| < \epsilon$
 whenever $n > m$ ☐
- (b) A necessary condition for a series $\sum u_n$ to converge is that
 $\lim_{n \rightarrow \infty} u_n = 0$ ☐
- (c) If $\lim_{n \rightarrow \infty} u_n = 0$ then the series $\sum u_n$ may or may not converge ☐
- (d) The series $1 + \frac{1}{2} + \frac{1}{3} + \dots + \frac{1}{n} + \dots$ is convergent ☐

3. Which one of the following statements is incorrect ?

- (a) If a series $\sum u_n$ be such that u_n does not tend to zero as n tends to infinity, then the series may or may not converge ☐
- (b) The series $\sqrt{\frac{1}{2}} + \sqrt{\frac{2}{3}} + \sqrt{\frac{3}{4}} + \dots$ is not convergent ☐
- (c) The sequence $\langle S_n \rangle$ of partial sums of a series of positive terms is a monotonic sequence which can never oscillate ☐
- (d) A series of positive terms can either converge or diverge ☐

4. Which of the following statements is incorrect ?

- (a) A series of positive terms is convergent if the sequence $\langle S_n \rangle$ of partial sums of the series is bounded ☐
- (b) The series $1 + r + r^2 + \dots$ is convergent if $r > 1$ ☐
- (c) The series $1 + r + r^2 + \dots$ is convergent if $0 < r < 1$ ☐
- (d) None of the above ☐

5. Which one of the following is not a form of comparison test ?

- (a) If $\sum u_n$ and $\sum v_n$ be two series of positive terms and let k be a positive number such that $u_n < kv_n$ for all $n > m$, m being a fixed positive integer. Then if the series $\sum v_n$ is convergent, $\sum u_n$ is also convergent and if $\sum v_n$ is divergent, $\sum u_n$ is also divergent ☐
- (b) If $\sum u_n$ and $\sum v_n$ be two series of positive terms such that ☐

$$\lim_{n \rightarrow \infty} \frac{u_n}{v_n} = l,$$

where l is a finite and nonzero number, then both the series converge or diverge together ☐

- (c) If $\sum u_n$ is a series of positive terms such that

$$\lim_{n \rightarrow \infty} \frac{u_n}{u_{n+1}} = l,$$

Then if $l > 1$, the series converges; if $l < 1$, the series diverges and if $l = 1$, the series may converge or diverge. Also if

$$\lim_{n \rightarrow \infty} \frac{u_n}{u_{n+1}} = \infty$$

then $\sum u_n$ converges ☐

- (d) Let $\sum u_n, \sum v_n$ be two series of positive terms such that

$$\frac{u_n}{u_{n+1}} > \frac{v_n}{v_{n+1}}$$

for all $n > m$. Then if $\sum v_n$ converges, $\sum u_n$ also converges and if $\sum u_n$ diverges, $\sum v_n$ also diverges ☐

6. Which one of following series is convergent?

(a) $\frac{1}{1^p} + \frac{1}{2^p} + \frac{1}{3^p} + \dots + \frac{1}{n^p} + \dots$

for $p > 1$ ☐

(b) $\frac{1}{1^p} + \frac{1}{2^p} + \frac{1}{3^p} + \dots + \frac{1}{n^p} + \dots$

for $p < 1$ ☐

(c) $\frac{1}{3} + \frac{\sqrt{2}}{5} + \frac{\sqrt{3}}{7} + \frac{\sqrt{4}}{9} + \dots$ ☐

(d) $1 + \frac{1}{2} + \frac{1}{3} + \dots + \frac{1}{n} + \dots$ ☐

7. The series $\frac{2}{1^p} + \frac{3}{2^p} + \frac{4}{3^p} + \dots$ is con-

vergent for

(a) $p > 0$ ☐

(b) $p > 1$ ☐

(c) $p > 2$ ☐

(d) $p > 3$ ☐

8. The series $\frac{1}{\log 2} + \frac{1}{\log 3} + \dots + \frac{1}{\log n}$

+.....is

(a) Convergent ☐

(b) Divergent ☐

(c) Neither convergent nor divergent ☐

(d) None of the above ☐

9. Let $\sum u_n$ be a series of positive terms and let $\lim (u_n)^{1/n} = l$. Then the series $\sum u_n$ converges or diverges according as $l < 1$ or $l > 1$. If $l = 1$, the series may either converge or diverge. This is—

(a) Raabe's Test ☐

(b) Cauchy's Root Test ☐

(c) Cauchy's Condensation Test ☐

(d) Kummer's Test ☐

10. The series whose n th term is given by

$$\frac{n^{n^2}}{(n+1)^{n^2}}, \text{ is}$$

(a) Convergent ☐

(b) Divergent ☐

(c) Cannot be determined ☐

(d) None of the above ☐

11. Let $\sum u_n$ be a series of positive terms such that

$$\lim_{n \rightarrow \infty} \frac{u_n}{u_{n+1}} = l$$

Then the series is convergent or divergent according as $l > 1$ or $l < 1$. If $l = 1$, then the series may either converge or diverge. This is —

(a) Comparison Test ☐

(b) D'Alembert's Ratio Test ☐

(c) Raabe's Test ☐

(d) Bertrand and Demorgan's Test ☐

12. The given series

$$1 + x + \frac{x^2}{2} + \frac{x^3}{3} + \dots$$

converges for

(a) All values of x ☐

(b) All values of x greater than 1 ☐

(c) All values of x less than 1 ☐

(d) All positive values of x ☐

13. The series

$$x + \frac{x^3}{3} + \frac{x^5}{5} + \dots \text{ is}$$

(a) Convergent for $x < 1$ and divergent for $x \geq 1$ ☐

- (b) Convergent for $x \leq 1$ and divergent for $x > 1$ ☐
 (c) Convergent for all values of x except $x=1$ ☐
 (d) None of the above ☐

14. Let $f(1), f(2), \dots, f(n), \dots$ be a sequence of positive terms such that

$$f(1) \geq f(2) \geq \dots \geq f(n) \geq \dots$$

for all n . Then the series—converge and diverge together

- (a) $\sum f(n)$ and $\sum f(2^n)$ ☐
 (b) $\sum f(n)$ and $\sum 2^n f(2^n)$ ☐
 (c) $\sum 2^n f(n)$ and $\sum f(2^n)$ ☐
 (d) $\sum f(n)$ and $\sum 2^{1/n} f(2^{1/n})$ ☐

15. The series $\sum \frac{1}{n(\log n)^p}$ is

- (a) Convergent if $p > 0$ ☐
 (b) Convergent if $p > 1$ ☐
 (c) Divergent if $p > 1$ ☐
 (d) Convergent if $0 < p < 1$ ☐

16. Which one of the following tests is known as Kummer's Test for testing whether a given $\sum u_n$ of positive terms is convergent or divergent?

- (a) If $\sum \frac{1}{d_n}$ is a divergent series such that

$$\lim_{n \rightarrow \infty} \left(d_n \frac{u_n}{u_{n+1}} - d_{n+1} \right) = l,$$

then the series $\sum u_n$ diverges if $l < 0$ and converges if $l > 0$ ☐

- (b) If $\frac{u_n}{u_{n+1}} = x + \frac{\beta}{n} + \frac{\gamma_n}{n^p}$

where $\alpha > 0, p > 1$ and $\langle \gamma_n \rangle$ is a bounded sequence, then $\sum u_n$ converges if $\alpha > 1$ and diverges if $\alpha < 1$ whatever value β may take and if $\alpha = 0$, then $\sum u_n$ converges or diverges according as $\beta > 1$ or $\beta \leq 1$ respectively ☐

- (c) Both (a) and (b) are different forms of Kummer's Test ☐
 (d) None of the above ☐

17. Both D'Alembert's Ratio Test and Raabe's Test are particular cases of

- (a) Kummer's Test ☐

- (b) Gauss's Test ☐
 (c) Cauchy's Condensation Test ☐
 (d) Both Kummer's Test and Gauss's Test ☐

18. Which one of the following tests can be directly applied for testing the convergence or divergence of a series of positive terms $\sum u_n$ without first applying the Ratio Test and Raabe's Test?

- (a) Bertrand and Demorgan's Test ☐
 (b) Gauss's Test ☐
 (c) Logarithmic Test ☐
 (d) None of the above ☐

19. Which one of the following series is not an alternating series?

- (a) $\frac{1}{1.2} + \frac{1}{3.4} + \frac{1}{5.6} + \dots$ ☐
 (b) $1 - \frac{1}{2\sqrt{2}} + \frac{1}{3\sqrt{3}} - \frac{1}{4\sqrt{4}} + \dots$ ☐
 (c) $\frac{\log 2}{2^2} - \frac{\log 3}{3^2} + \frac{\log 4}{4^2} - \dots$ ☐
 (d) None of the above ☐

20. The alternating series

$$u_1 - u_2 + u_3 - u_4 + \dots (u_n > 0 \leq n)$$

is convergent if

- (a) $u_{n+1} \leq u_n \forall n$ ☐
 (b) $u_n \rightarrow 0$ as $n \rightarrow \infty$ ☐
 (c) $u_{n+1} \leq u_n \forall n$ and $u_n \rightarrow 0$ as $n \rightarrow \infty$ ☐
 (d) Either $u_{n+1} \leq u_n \forall n$ or $u_n \rightarrow 0$ as $n \rightarrow \infty$ ☐

21. A series $\sum u_n$ is said to be absolutely convergent if the series $\sum |u_n|$ is convergent.

The series $1 + x + \frac{x^2}{2} + \dots$ converges for

- (a) All values of $x > 1$ ☐
 (b) All value of $x < 1$ ☐
 (c) All value of x ☐
 (d) All value of x lying between 0 and 1 ☐

22. A conditionally convergent series is

- (a) Both convergent and absolutely convergent ☐

- (b) Convergent but not absolutely convergent ☐
 (c) Absolutely convergent but not convergent ☐
 (d) Not necessarily convergent ☐
 23. Which of the following series is convergent?

- (a) $\sum \sin \frac{1}{n}$ ☐
 (b) $\sum \cos \frac{1}{n}$ ☐
 (c) $\sum \tan^{-1}\left(\frac{1}{n}\right)$ ☐
 (d) $\sum \frac{1}{an^2+1}$ ☐

24. Demorgan's and Bertrand's Test for testing the convergence or divergence of a series $\sum u_n$ of positive terms is applied when... fails

- (a) Raabe's Test ☐
 (b) Ratio Test ☐
 (c) Gauss's Test ☐
 (d) Cauchy's Root Test ☐

25. If $\frac{u_n}{u_{n+1}} = \frac{n^k + An^{k-1} + Bn^{k-2} + \dots}{n^k + an^{k-1} + bn^{k-2} + \dots}$

where k is a positive integer, then the series $u_1 + u_2 + u_3 + \dots$ is convergent if

- (a) $A - a > 1$ ☐
 (b) $A - a < 1$ ☐
 (c) $A > a - 1$ ☐
 (d) $A > a$ ☐

26. The series

$x + x^{1+1/2} + x^{1+1/2+1/3} + \dots$ is convergent is

- (a) $x < e$ ☐
 (b) $x < 1/e$ ☐

- (c) $x > e$ ☐
 (d) $x > 1/e$ ☐
 27. The series

$$1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \dots \text{ is}$$

- (a) Absolutely convergent ☐
 (b) Convergent ☐
 (c) Divergent ☐
 (d) Convergent but not absolutely convergent and hence conditionally convergent ☐

28. In the series

$$1 - \frac{1}{2} + \frac{1}{3} - \frac{1}{4} + \dots,$$

the rearrangement of terms alters the sum of the series because it is

- (a) A conditionally convergent series ☐
 (b) Absolutely convergent series ☐
 (c) Absolutely convergent but not conditionally convergent ☐
 (d) Divergent series ☐

29. Which of the following statements is incorrect?

- (a) Dirichlet's theorem is associated with the absolute convergence of a series obtained from an absolutely convergent series by a rearrangement of terms ☐
 (b) Riemann's theorem states that terms of any conditionally convergent series can be rearranged to give a divergent or oscillatory series always ☐
 (c) A series obtained from a convergent series by a grouping of terms converges always without altering its sum ☐
 (d) None of the above ☐

ANSWERS

- | | | | | | |
|-------|-------|-------|-------|-------|-------|
| 1. c | 2. d | 3. a | 16. a | 17. d | 18. b |
| 4. b | 5. c | 6. a | 19. d | 20. c | 21. c |
| 7. c | 8. b | 9. b | 22. b | 23. d | 24. a |
| 10. a | 11. b | 12. d | 25. a | 26. b | 27. d |
| 13. a | 14. b | 15. b | 28. a | 29. b | |

Differential Equations

1. Which one of the following is an ordinary differential equation?

(a) $\frac{\delta y}{\delta x} + \frac{\delta y}{\delta z} = x + z$ ☐

(b) $y^2 + x^2 = \frac{d}{dx}(x\alpha + 1)$ ☐

(c) $\frac{d(y+x)}{dx} = x^2 + \sin x$ ☐

(d) $\frac{d(e^x + x^2)}{dx} = x^2$ ☐

2. The order of the differential equation is defined as the

(a) Power of the highest order derivative occurring in the equation ☐

(b) Highest order derivative occurring in the equation ☐

(c) Highest power among the powers of the derivatives occurring in the equation. ☐

(d) Highest power of the dependent variable occurring in the equation. ☐

3. Which of the following differential equations is of order three?

(a) $\left(\frac{d^2y}{dx^2}\right)^3 + \left(\frac{dy}{dx}\right)^5 + y^2 = x + e^x$ ☐

(b) $x^2 \left(\frac{dy}{dx}\right)^2 + x^3 y^3 = Ax + B$ ☐

(c) $8 \frac{d^2y}{dx^2} + 3 \frac{dy}{dx} + 5 \int y dx = \frac{7x^2}{2}$ ☐

(d) None of the above ☐

4. Which of the following differential equations is of order one?

(a) $\frac{dy}{dx} + 7y = 5 \int x dx$ ☐

(b) $\left(\frac{d^2y}{dx^2}\right)^{1/2} + \sin x \left(\frac{dy}{dx}\right)^3 + xy = x$ ☐

(c) $\frac{d^2y}{dx^2} + (2x+1) \frac{dy}{dx} + y = x$ ☐

(d) None of the above ☐

5. The degree of the differential equation is defined as the

(a) Highest of the orders of the differential coefficients occurring in it ☐

(b) Highest power of the highest order differential coefficient occurring in it ☐

(c) Any power of the highest order differential coefficient occurring in it ☐

(d) Highest power among the powers of the differential coefficients occurring in it ☐

6. What is the degree of the differential equation

$$y = x \frac{dy}{dx} + \sin\left(\frac{dy}{dx}\right)?$$

(a) 1 ☐

(b) 2 ☐

(c) 8 ☐

(d) Cannot be determined ☐

7. Let m be the order of a differential equation. Then

(a) m is not unique ☐

(b) m is unique ☐

(c) m may or may not be unique ☐

(d) m may be infinite ☐

8. Let m be the order of a given differential equation. Then

(a) m is any integer ☐

- (b) m is any real number ☐
 (c) m is any positive integer ☐
 (d) m is any non-negative integer ☐

9. Which of the following differential equations is not of degree 1?

- (a) $x^3 \frac{d^2y}{dx^2} + (x+x^2) \left(\frac{dy}{dx} \right)^2 + e^x y^3 = \sin x$ ☐
 (b) $y = 2 \frac{d^2y}{dx^2} + 3 \sqrt{1 - \left(\frac{dy}{dx} \right)^2}$ ☐
 (c) $\left(\frac{d^2y}{dx^2} \right)^{1/2} + \sin x \left(\frac{dy}{dx} \right)^2 + xy = x$ ☐
 (d) All of the above are differential equations of degree 1 ☐

10. Which of the following differential equations is of degree 4?

- (a) $\left[1 + 2 \left(\frac{dy}{dx} \right)^2 + 3 \left(\frac{d^2y}{dx^2} \right) \right]^{3/2} = 4 \left(\frac{d^3y}{dx^3} \right)^2$ ☐
 (b) $\left(\frac{d^3y}{dx^3} \right)^2 + x \left(\frac{d^2y}{dx^2} \right)^4 + x^2 \frac{dy}{dx} + x + y = 0$ ☐
 (c) $\sqrt{1 + \left(\frac{dy}{dx} \right)^3} = 2 \frac{d^2y}{dx^2}$ ☐
 (d) $y = x \frac{dy}{dx} + 5 \sqrt{1 + \left(\frac{dy}{dx} \right)^4}$ ☐

11. If n denotes the degree of a given differential equation, then

- (a) n is any natural number ☐
 (b) n is any integer ☐
 (c) n can be zero ☐
 (d) n is any non-negative integer ☐

12. If m denotes the order and n the degree of a given differential equation respectively, then

- (a) $m = n$ ☐
 (b) $m < n$ ☐
 (c) $m > n$ ☐
 (d) None of the above ☐

13. If m and n are the order and degree of the differential equation

$$\left(\frac{d^2y}{dx^2} \right)^7 + 9 \frac{\left(\frac{d^2y}{dx^2} \right)^5}{\frac{d^3y}{dx^3}} + \frac{d^3y}{dx^3}$$

$= x^7 + 9x^5 + 1$, then

- (a) $m = 3, n = 7$ ☐
 (b) $m = 2, n = 5$ ☐
 (c) $m = 3, n = 2$ ☐
 (d) $m = 3, n = 1$ ☐

14. If m and n be the order and degree of the differential equation

$$y^3 \left(\frac{d^2y}{dx^2} \right)^2 + x \frac{dy}{dx} + x^2 y^2 = \sin x, \text{ then}$$

- (a) $m = n$ ☐
 (b) $m > n$ ☐
 (c) $m < n$ ☐
 (d) None of the above ☐

15. Which of the following differential equations is of first order and second degree?

- (a) $\left(\frac{d^2y}{dx^2} \right)^{1/2} + \sin x \left(\frac{dy}{dx} \right)^3 + xy = x$ ☐
 (b) $x^3 \left(\frac{dy}{dx} \right)^2 + x y^3 = e^x$ ☐
 (c) $\frac{dy}{dx} + x^2 y^2 + xy = e^x$ ☐
 (d) $(1+x^2) \frac{d^2y}{dx^2} + 1 + \left(\frac{dy}{dx} \right)^2 = 0$ ☐

16. The solution of the differential equation

$$\left(2 \frac{d^2y}{dx^2} - y \right)^2 = 9 \left[1 - \left(\frac{dy}{dx} \right)^2 \right]$$

is given by

- (a) $y = \sin x$ ☐
 (b) $y = \cos x$ ☐
 (c) Both $y = \sin x$ and $y = \cos x$ ☐
 (d) $y = \sec x$ ☐

17. Which of the following is a solution of the differential equation

$$\left(-x \frac{dy}{dx} \right)^2 = 9 \left[1 + \left(\frac{dy}{dx} \right)^4 \right] ?$$

- (a) $(y-x)^2 = 153$ ☐

- (b) $(y-2x)^2=144$ ☐
 (c) $(y-3x)^2=153$ ☐
 (d) $(y-2x)^2=153$ ☐

18. Which of the following solutions of the differential equation

$$y = x \frac{dy}{dx} + \frac{5}{dy/dx}$$

is a singular solution ?

- (a) $y = cx + \frac{5}{c}$ ☐
 (b) $3y = 9x + 5$ ☐
 (c) $y = 5x + 1$ ☐
 (d) $y^2 = 20x$ ☐

19. A singular solution of the given differential equation is

- (a) Either a general solution or a particular solution ☐
 (b) Neither a general solution nor a particular solution but contains the arbitrary constants ☐
 (c) Neither a general solution nor a particular solution and does not contain any arbitrary constant ☐
 (d) Known as a general solution ☐

20. Which one of the following is a differential equation of the family of curves

$$y = Ae^{2x} + Be^{-2x}$$

for different values of A and B ?

- (a) $\frac{d^2y}{dx^2} - 2 \frac{dy}{dx} + 2y = 0$ ☐
 (b) $x \frac{d^2y}{dx^2} + 2 \frac{dy}{dx} - xy + x^2 - 2 = 0$ ☐
 (c) $\frac{d^2y}{dx^2} = 4y$ ☐
 (d) $\left(\frac{dy}{dx}\right)^3 = 4y \left(x \frac{dy}{dx} - 2y\right)$ ☐

21. The differential equation of all circles of radius a is given by

- (a) $\left[1 + \left(\frac{dy}{dx}\right)^2\right]^3 = a^2 \left(\frac{d^2y}{dx^2}\right)^2$ ☐
 (b) $\left[1 + \left(\frac{dy}{dx}\right)^2\right]^{3/2} = a^2 \left(\frac{d^2y}{dx^2}\right)^2$ ☐

- (c) $\left[1 + \left(\frac{d^2y}{dx^2}\right)^2\right]^{3/2} = a^2 \left(\frac{dy}{dx}\right)^2$ ☐
 (d) $\frac{dy}{dx} = \frac{y^2 - x^2}{2xy}$ ☐

22. A differential equation is said to be linear if

(a) x , y and the derivatives of y are of first degree and product of these do not occur in it. ☐

(b) y and its derivatives are of first degree but products of these do not occur in it. ☐

(c) The derivatives of y are all of the first degree. ☐

(d) The dependent variable occurs linearly. ☐

23. Which of the following differential equations is linear ?

(a) $(1+y) \frac{dy}{dx} + xy = \sin x$ ☐

(b) $y \frac{dy}{dx} + x = 0$ ☐

(c) $(1+y) \frac{dy}{dx} + \sin x = 0$ ☐

(d) $\frac{d^2y}{dx^2} + x^2 \frac{dy}{dx} = (1+x)^3 y$
 $= \sin x + e^x$ ☐

24. Which of the following differential equations is linear but not of first degree ?

(a) $(x+y+xy) \frac{dy}{dx} + (\sin x + x)y = 0$ ☐

(b) $\frac{dy}{dx} + xy^2 = \sin x$ ☐

(c) $\frac{d^2y}{dx^2} + \frac{dy}{dx} + xy^2 = 0$ ☐

(d) None of the above ☐

25. A differential equation of first degree

(a) Is always linear ☐

(b) Is of first order ☐

(c) May or may not be linear ☐

(d) Is never of first order but is linear always ☐

26. A linear differential equation

- (a) Is necessarily of first order ☐
 (b) Is necessarily of first degree ☐
 (c) May or may not be of first degree but of first order ☐
 (d) Either of first order or of first degree ☐

27. Which one of the following is a standard form of the first order differential equations of first degree?

- (a) $\frac{dy}{dx} = f(x, y)$ ☐
 (b) $M(x, y)dx + N(x, y)dy = 0$ ☐
 (c) Both of the above ☐
 (d) None of the above ☐

28. If M and N are functions of x and y , then the equation $Mdx + Ndy = 0$ is exact if

- (a) $\exists$ a function $f(x, y)$ of x and y such that $f(x, y) = Mdx + Ndy$ ☐
 (b) $\exists$ a function $f(x, y)$ of x and y such that

$\frac{\partial f}{\partial x} dx + \frac{\partial f}{\partial y} dy = Mdx + Ndy$ ☐

- (c) $\exists$ a function $u(x)$ of x alone such that $d[u(x)] = Mdx + Ndy$ ☐
 (d) $\exists$ a function $v(y)$ of y alone such that $d[v(y)] = Mdx + Ndy$ ☐

29. The necessary and sufficient condition for the differential equation

$$M(x, y)dx + N(x, y)dy = 0$$

to be exact is that

- (a) $\frac{\partial M}{\partial y} = \frac{\partial N}{\partial x}$ ☐
 (b) $\frac{\partial M}{\partial y} = -\frac{\partial N}{\partial x}$ ☐
 (c) $\frac{\partial M}{\partial x} = \frac{\partial N}{\partial y}$ ☐
 (d) $\frac{\partial M}{\partial x} = -\frac{\partial N}{\partial y}$ ☐

30. If $P(x)$ and $Q(y)$ are arbitrary functions of x and y respectively, then the differential equation $P(x)dx + Q(y)dy = 0$

- (a) May or may not be exact ☐

- (b) Is never exact ☐
 (c) Is always exact ☐
 (d) Is exact only when $P(x) = x$ and $Q(y) = y$ ☐

31. If $P(y)$ and $Q(x)$ are arbitrary functions of y and x respectively, then the differential equation $P(y)dx + Q(x)dy$

- (a) Is never exact ☐
 (b) Is exact if $P(y) = e^y$ and $Q(x) = e^x$ ☐
 (c) Is exact only if $P(y) = Ay + B$ and $Q(x) = Ax + C$, A, B, C being constants ☐
 (d) Is always exact ☐

32. Which of the following differential equations is exact?

- (a) $(y^2 + x)dx + (y^3 + x)dy = 0$ ☐
 (b) $(x + y)(dx - dy) = dx + dy$ ☐
 (c) $2xydx + (x + y^2)dy = 0$ ☐
 (d) None of the above ☐

33. Which of the following differential equations is exact?

- (a) $\{\cos x \tan y + \cos(x + y)\}dx + \{\sin x \sec^2 y + \cos(x + y)\}dy = 0$ ☐
 (b) $(\sin x + \cos x)dx + (\sin x - \cos x)dy = 0$ ☐
 (c) $[\cos x \tan y - \sin(x + y)]dx + [\sin x \sec^2 y + \cos(x + y)]dy = 0$ ☐
 (d) $(\sin y + \cos y)dx + x \sin y dy = 0$ ☐

34. Which of the following provides a solution of the exact differential equation

$$\left\{ y \left(1 + \frac{1}{x} \right) \cos y \right\} dx + \left\{ x + \log x - x \sin y \right\} dy = 0$$

- (a) $xy + ye^x + x \cos y = \text{const.}$ ☐
 (b) $xy + y \log x + x \cos y = \text{const.}$ ☐
 (c) $xy + x \log y + x \sin y = \text{const.}$ ☐
 (d) $2xy + 2y \log x + x \sin y = \text{const.}$ ☐

35. Which of the following provides a solution of the exact differential equation

$$\{y^2 e^{xy^3} + 4x^3\}dx + \{2xy e^{xy^3} - 3y^2\}dy = 0?$$

- (a) $e^{xy^2} + x^4 + y^3 = \text{constant}$ ☐
 (b) $2e^{xy^2} + x^4 - y^3 = \text{constant}$ ☐
 (c) $e^{xy^2} + x^4 - y^3 = \text{constant}$ ☐
 (d) $e^{xy^2} - x^4 + y^3 = \text{constant}$ ☐

36. Which of the following is not an exact differential?

- (a) $\frac{ydx - xdy}{y^2}$ ☐
 (b) $\frac{xdy - ydx}{x^2}$ ☐
 (c) $xdy - ydx$ ☐
 (d) $\frac{xdy - ydx}{xy}$ ☐

37. Which of the following is an exact differential?

- (a) $\frac{ydx + xdy}{x^2 + y^2}$ ☐
 (b) $\frac{xdy - ydx}{x^2 + y^2}$ ☐
 (c) $\frac{ydx - xdy}{xy}$ ☐
 (d) All of the above ☐

38. Which of the following is an exact differential?

- (a) $\frac{2x^2y dx - 2xy^2 dy}{x^4}$ ☐
 (b) $\frac{2yx dx + x^2 dy}{y^2}$ ☐
 (c) $\frac{2xy dy + y^2 dx}{x^2}$ ☐
 (d) None of the above ☐

39. Which of the following is not an exact differential?

- (a) $\frac{xe^y dy + e^y dx}{x^2}$ ☐
 (b) $\frac{ye^x dx - e^x dy}{y^2}$ ☐
 (c) $-\left(\frac{xdy + ydx}{x^2 + y^2}\right)$ ☐
 (d) All of the above are exact differentials ☐

40. The integrating factor of the differential equation $xdy - ydx = xy^2 dx$ is

- (a) $\frac{1}{x^2}$ ☐
 (b) $\frac{1}{y^2}$ ☐
 (c) $\frac{1}{xy}$ ☐
 (d) $\frac{1}{x^2 y^2}$ ☐

41. If I_1 and I_2 be the integrating factors of the differential equations

$$(1+xy)ydx + (1-xy)xdy = 0 \text{ and } (x^2y - 2xy^2)dx - (x^3 - 3x^2y)dy = 0$$

respectively, then

- (a) $I_1 = -I_2$ ☐
 (b) $I_1 = \frac{1}{I_2}$ ☐
 (c) $I_1 = I_2$ ☐
 (d) $I_1 I_2 = -1$ ☐

42. The integrating factor of differential equation $(xy \sin xy + \cos xy)ydx$

$$+ (xy \sin xy - \cos xy)xdy = 0 \text{ is}$$

- (a) $\frac{1}{2xy \sin xy}$ ☐
 (b) $\frac{1}{2xy \cos xy}$ ☐
 (c) $2xy \sin xy$ ☐
 (d) $2xy \cos xy$ ☐

43. The integrating factor of the differential equation $(x^2 + y^2 + 2x)dx + 2ydy = 0$ is

- (a) e^x ☐
 (b) e^{-x} ☐
 (c) $\log x$ ☐
 (d) e^{xy} ☐

44. The integrating factor of the differential equation

$$(y^4 + 2y)dx + (xy^3 + 2y^4 - 4x)dy = 0$$

is

- (a) $e^{3 \log y}$ ☐

(b) $e^{-3 \log y}$ ☐

(c) $\frac{-3}{y}$ ☐

(d) $\frac{-1}{y^3}$ ☐

A differential equation is said to be with separated variables if it can be written in the form of

$$P(x)dx + Q(y)dy = 0$$

45. Which of the following differential equations is with separated variables?

(a) $e^{x+y}dx + \sin x \cos y dy = 0$ ☐

(b) $\sin(x+y)dx + \cos(xy)dy = 0$ ☐

(c) $(x+e^y)dx + (y-x)dy = 0$ ☐

(d) $e^{xy}dx + \sin(x+y)dy = 0$ ☐

46. Which of the following differential equations is with separated variables?

(a) $\log \left(\frac{dy}{dx} \right) = ax + by$ ☐

(b) $dy = (e^{x-y} + x^2 e^{-y})dx$ ☐

(c) $\tan y dy = [\sin(x+y) + \sin(x-y)]dx$ ☐

(d) All of the above equations are with separated variables ☐

47. The differential equation $(x+y)[dx-dy] = dx+dy$, which is not with separated variables, can be transformed into one which is with separated variables, by the substitution

(a) $x+y-1=v$ ☐

(b) $x+y+1=v$ ☐

(c) $x+y=v$ ☐

(d) None of the above ☐

48. The differential equation

$$\frac{dy}{dx} = \frac{4x+6y+5}{3y+2x+4}, \text{ which is}$$

not with separated variables, can be transformed into one which is with separated variables, by the substitution

(a) $2x+3y=v$ ☐

(b) $4x+6y+5=v$ ☐

(c) $3y+2x+4=v$ ☐

(d) $3x+2y=v$ ☐

49. Which of the following differential equations is not homogeneous one?

(a) $(x^2-y^2)dx + 2xydy = 0$ ☐

(b) $x \cos \left(\frac{y}{x} \right) (ydx + xdy)$

$= y \sin \left(\frac{y}{x} \right) (xdy - ydx)$ ☐

(c) $(1+e^{x/y})dx + e^{x/y}(1-x/y)dy = 0$ ☐

(d) $(2x-3y-5)dy + (3x+2y-5)dx = 0$ ☐

50. Which one of the following statements is correct?

(a) A differential equation is exact iff it is with separated variables ☐

(b) If a differential equation is exact, then it is with separated variables but not conversely ☐

(c) If a differential equation is with separated variables, then it is exact ☐

(d) If a differential equation is exact, then it is with separated variables ☐

51. The solution curves of the given differential equation

$$xdx + ydy = 0$$

are given by a family of

(a) Circles ☐

(b) Parabolas ☐

(c) Ellipses ☐

(d) Straight lines passing through the origin ☐

52. The solution curves of the given differential equation

$$xdx - dy = 0$$

are given by a family of

(a) Parabolas ☐

(b) Hyperbolas ☐

(c) Circles ☐

(d) Ellipses ☐

53. A first order first degree homogeneous differential equation

(a) Can always be reduced to an exact form ☐

(b) Can never be reduced to an exact form ☐

- (c) May or may not be reduced to an exact form ☐
- (d) Can only be reduced to an exact form if the given differential equation is linear ☐

54. A first order first degree homogeneous differential equation

- (a) Can always be reduced to an equation with separated variables ☐
- (b) Can never be reduced to an equation with separated variables ☐
- (c) May or may not be reduced to an equation with separated variables ☐
- (d) Can only be reduced to an equation with separated variables when the given equation is linear ☐

55. Which of the following transformations reduces a homogeneous differential equation of first order and first degree into one with separated variables?

- (a) $y=v/x$ ☐
- (b) $y=vx$ ☐
- (c) $y=vx^2$ ☐
- (d) $y=v/x^2$ ☐

56. The transformation $y=vx$ reduces the given homogeneous differential equation

$$\frac{dy}{dx} = 1 + \frac{v}{x} \text{ to}$$

- (a) $\frac{dv}{dx} = 1 + v$ ☐
- (b) $x \frac{dv}{dx} = v$ ☐
- (c) $x \frac{dv}{dx} = 1$ ☐
- (d) $v \frac{dv}{dx} = 1$ ☐

57. Which of the following transformations reduces the given differential equation

$$\frac{dy}{dx} = \frac{x-y+1}{x+2y-3}$$

into homogeneous one?

- (a) $x=X-3, y=Y-4$ ☐
- (b) $x=X+1/3, y=Y+4/3$ ☐
- (c) $x=X+5, y=Y-4$ ☐

(d) $x=X-5, y=Y+4$ ☐

58. A general linear differential equation of first order can be written as

- (a) $\frac{dy}{dx} + P(x, y)y = Q(x, y)$ ☐
- (b) $\frac{dy}{dx} + P(x)y = Q(x)$ ☐
- (c) $\frac{dy}{dx} + P(x)y = 0$ ☐
- (d) None of the above ☐

59. Which of the following differential equations is linear, homogeneous and of first order?

- (a) $\frac{dy}{dx} + (1+x)y = 0$ ☐
- (b) $\frac{dy}{dx} + e^x y = \cos x$ ☐
- (c) $\frac{dy}{dx} + (x^2 + y^2)y = \sin x$ ☐
- (d) $\frac{dy}{dx} + x = 0$ ☐

60. The integrating factor of the differential equation

$$\frac{dy}{dx} + P(x)y = Q(x)$$

depends upon

- (a) $P(x)$ only ☐
- (b) $Q(x)$ only ☐
- (c) Both $P(x)$ and $Q(x)$ ☐
- (d) $P(x)$ but may or may not depend upon $Q(x)$ ☐

61. The integrating factor of the differential equation

$$\frac{dy}{dx} + P(x)y = Q(x)$$

is defined as

- (a) $\int P(x) dx$ ☐
- (b) $e^{\int P(x) dx}$ ☐
- (c) $\int Q(x) dx$ ☐
- (d) $e^{\int Q(x) dx}$ ☐

62. If f_1 and f_2 be the integrating factors of the differential equations

$$x \frac{dy}{dx} + 2y = 1 \text{ and}$$

$$\frac{dy}{dx} - \frac{2}{x}y = \frac{1}{x} \text{ respectively}$$

then

(a) $f_1 = x^4 f_2$ ☐

(b) $f_1 = x^3 f_2$ ☐

(c) $f_1 = x^2 f_2$ ☐

(d) $f_1 = f_2$ ☐

63. Which of the following statements is correct?

(a) No two differential equations can have the same integrating factor ☐

(b) Infinitely many differential equations can have the same integrating factor ☐

(c) Only a finite number of differential equations can have the same integrating factor ☐

(d) None of the above ☐

64. The integrating factor of the differential equation

$$\frac{dy}{dx} (x \log x) + y = 2 \log x$$

is given by

(a) $\log(\log x)$ ☐

(b) $\log x$ ☐

(c) e^x ☐

(d) x ☐

65. The integrating factor of the differential equation

$$\sin x \frac{dy}{dx} + 3y = \cos x$$

is calculated as

(a) $e^{\tan^3 x/2}$ ☐

(b) $\log \tan x/2$ ☐

(c) $\tan^3 x/2$ ☐

(d) $\tan x/2$ ☐

66. The integrating factor of the differential equation

$$(2x-10y^3) \frac{dy}{dx} + y = 0$$

is calculated as

(a) y^2 ☐

(b) x^2 ☐

(c) e^{y^2} ☐

(d) e^{x^2} ☐

67. The solution of the differential equation

$$\frac{dy}{dx} + P(x)y = Q(x)$$

is given by

(a) $y = e^{\int P dx} \{ \int Q \cdot e^{\int P dx} dx + c \}$ ☐

(b) $y = e^{-\int P dx} \{ \int Q \cdot e^{-\int P dx} dx + c \}$ ☐

(c) $y = e^{-\int P dx} \{ \int Q \cdot e^{\int P dx} dx + c \}$ ☐

(d) $y = \int Q e^{\int P dx} dx + c$ ☐

68. The differential equation of the type

$$\frac{dy}{dx} + P(x)y = Q(x)y^n$$

is known as

(a) Bessel's equation ☐

(b) Clairaut's equation ☐

(c) Auxiliary equation ☐

(d) Bernoulli's equation ☐

69. Which of the following transformations reduces the differential equation

$$\frac{dy}{dx} - \frac{\tan y}{1-x} = (1+x) e^x \sec y$$

into the form

$$\frac{dz}{dx} + P(x)z = Q(x) ?$$

(a) $z = \sin y$ ☐

(b) $z = \cos y$ ☐

(c) $z = \csc y$ ☐

(d) $z = \tan y$ ☐

70. Which of the following transformations reduces the differential equation

$$\frac{dz}{dx} + \frac{z}{x} \log z = \frac{z}{x^2} (\log z)^2$$

into the form

$$\frac{dy}{dx} + P(x)y = Q(x) ?$$

- (a) $v = \log z$ ☐
 (b) $v = e^z$ ☐
 (c) $v = \frac{1}{\log z}$ ☐
 (d) $z = (\log z)^2$ ☐

71. The transformation $v = \frac{1}{y}$ transforms which of the following differential equations into the form

$$\frac{dy}{dx} + P(x)y = Q(x) ?$$

- (y log x - 1)ydx = xdy ... (1)
 $\frac{dy}{dx} - y \tan x = -y^2 \sec x$... (2)
 $ydx - xdy + 3x^2y^2e^{x^3}dx = 0$... (3)
 $(x^3y^2 + xy^3)dx = dy$... (4)
 (a) (1), (2) and (3) only ☐
 (b) (1), (2) and (4) only ☐
 (c) (3) and (4) only ☐
 (d) (1), (2), (3) and (4) ☐

72. The general solution of the differential equation

$$\frac{dy}{dx} + y \frac{d\phi}{dx} = \phi(x), \text{ where}$$

ϕ is a function of x alone, is given by

- (a) $y = \phi + ce^{-\phi}$ ☐
 (b) $y = \phi + 1 - ce^{-\phi}$ ☐
 (c) $y = \phi - 1 + ce^{\phi}$ ☐
 (d) $y = \phi - 1 + ce^{-\phi}$ ☐

73. The equation $xdy = ydx$ represents the family of

- (a) Circles ☐
 (b) Ellipses ☐
 (c) Hyperbolas ☐
 (d) Straight lines ☐

74. The equation $xdy + ydx = 0$ represents a family of

- (a) Hyperbolas ☐
 (b) Parabolas ☐
 (c) Straight lines ☐
 (d) Circles ☐

75. The one parameter family $y = cx^2$ can be written as

- (a) $x \frac{dy}{dx} = 2y$ ☐
 (b) $y \frac{dy}{dx} = 2x$ ☐
 (c) $x \frac{dy}{dx} = y$ ☐
 (d) $y \frac{dy}{dx} = x$ ☐

76. A curve is called an isogonal trajectory or an α -trajectory of the family $f(x, y, c) = 0$ if

- (a) It intersects only one member of the family at an angle α ☐
 (b) It intersects atleast one member of the family at an angle α ☐
 (c) It intersects every member of the family at an angle α ☐
 (d) It intersects either none of member of the family or every member of the family at an angle α ☐

77. In order to find a family of orthogonal trajectories of the family of curves

$$f\left(x, y, \frac{dy}{dx}\right) = 0, \text{ which of the following}$$

replacements is made ?

- (a) $\frac{dy}{dx}$ is replaced by $-\frac{dx}{dy}$ ☐
 (b) $\frac{dy}{dx}$ is replaced by $\frac{dx}{dy}$ ☐
 (c) $\frac{y}{x}$ is replaced by $\frac{x}{y}$ ☐
 (d) $\frac{x}{y}$ is replaced by $-\frac{x}{y}$ ☐

78. The orthogonal trajectories of the given family of curves $y = cx^2$ are given by

- (a) $x^2 + cy^2 = \text{const}$ ☐
 (b) $x^2 + ky^2 = \text{const}$ ☐
 (c) $kx^2 + y^2 = \text{const}$ ☐
 (d) $x^2 - ky^2 = \text{const}$ ☐

79. The orthogonal trajectories of a given family of curves $r = a\theta$ is given by

- (a) $r = ce^{\theta^2/2}$ ☐
 (b) $r = ce^{-\theta^2/2}$ ☐

(c) $r = ce^{\theta^2}$ ☐

(d) $r = ce^{\theta}$ ☐

80. Which one of the following is a general solution of the differential equation

$$xp^2 + (y-x)p - y = 0, \text{ where}$$

$$p = \frac{dy}{dx} ?$$

(a) $(y-x-c)(y^2+x^2-c)=0$ ☐

(b) $(y+\frac{1}{2}x^2-c)(x+\log y-c)=0$ ☐

(c) $(y-\frac{1}{2}x^2-c)(y+\frac{3}{2}x^2-c)=0$ ☐

(d) $(y-x-c)(xy+c)=0$ ☐

81. Which one of the following is a general solution of the differential equation

$$p^2 - 2p \cosh x + 1 = 0 ?$$

(a) $(y - e^x - c)(y + e^{-x} - c) = 0$ ☐

(b) $(y + e^x - c)(y - e^{-x} - c) = 0$ ☐

(c) $(y + \log x - c)(y + e^{-x} - c) = 0$ ☐

(d) $(y - e^x - c)(y - \log x - c) = 0$ ☐

82. Which one of the following is a general solution of the differential equation

$$y = 2px + p^2y ?$$

(a) $2yc - x^2 + c^2 = 0$ ☐

(b) $2xc + y^2 - c^2 = 0$ ☐

(c) $2xc - y^2 + c^2 = 0$ ☐

(d) $yc + x^2 + c^2 = 0$ ☐

83. Which one of the following is a general solution of the differential equation

$$y - 2px = f(xp^2) ?$$

(a) $y = \sqrt{2cx} + f(c)$ ☐

(b) $y = 2cx + f(c)$ ☐

(c) $y = 2\sqrt{cx} + f(c)$ ☐

(d) $y = 4c^2x^2 + f(c)$ ☐

84. The differential equation of the form $y = xF(p) + f(p)$ is known as

(a) Bernoulli's equation ☐

(b) Lagrange's equation ☐

(c) Clairaut's equation ☐

(d) Cauchy's integral equation ☐

85. Which of the following differential equations is known as Clairaut's equation ?

(a) $y = xp^2 + f(p)$ ☐

(b) $y = xp + f(p)$ ☐

(c) $y = xp + f(x, y)$ ☐

(d) $y = F(p) + f(x)$ ☐

86. The general solution of the differential equation

$$(y-px)(p-1)=p \text{ is given by}$$

(a) $y = cx + \frac{c}{(c+1)}$ ☐

(b) $y^2 = 4cx$ ☐

(c) $y = \sqrt{cx + \frac{c}{c-1}}$ ☐

(d) $y = cx + \frac{c}{(c-1)}$ ☐

87. The general solution of the differential equation $\sin(y-px)=p$ is given by

(a) $x = cx + \sin c$ ☐

(b) $y = cx - \sin c$ ☐

(c) $y = cx + \sin^{-1}c$ ☐

(d) $y = cx + \cos c$ ☐

89. The differential equation

$$e^{3x}(p-1) + p^3e^{2y} = 0$$

can be reduced to Clairaut's form by means of the substitution

(a) $e^{2y} = v$ and $e^{3x} = u$ ☐

(b) $e^y = v$ and $e^x = u$ ☐

(c) $v = \log y$ and $u = \log x$ ☐

(d) $y^2 = v$ only ☐

89. Which of the following differential equations cannot be transformed to the Clairaut's form by means of the substitution

$$x^2 = u \text{ and } y^2 = v ?$$

(a) $(px-y)(py+x) = h^2p$ ☐

(b) $yp^2 + x^3p - x^2y = 0$ ☐

(c) $xy(y-px) = x + yp$ ☐

(d) $(y+xp)^2 = x^2p$ ☐

90. The differential equation

$$x^2p^2 + yp(2x+y) + y^2 = 0$$

can be reduced to the Clairaut's form by means of which of the following substitutions ?

(a) $y = u$ and $x^2 = v$ ☐

(b) $x = u$ and $y^2 = v$ ☐

(c) $xy = v$ and $y = u$ ☐

(d) $\frac{x}{y} = v$ and $y = u$ ☐

91. Which of the following statements is incorrect regarding the singular solutions of the differential equations ?

- (a) The singular solution does not contain any arbitrary constant ☐

- (b) Singular solution is a particular case of the general solution ☐

- (c) Sometimes it is possible to deduce the singular solution from the general solution by assigning a particular value to the arbitrary constant therein ☐

- (d) If $f(x, y)=0$ is a singular solution of the differential equation $f(x, y, p)=0$ whose general solution is $\phi(x, y, c)=0$, then $f(x, y)$ is a factor of both p as well as c -discriminants and also satisfies the given differential equation ☐

92. To obtain the singular solution of the differential equation in Clairaut's form, it is necessary to calculate

- (a) p -discriminant only ☐
 (b) c -discriminant only ☐
 (c) Both the p and c -discriminants ☐
 (d) Any one of the p and c discriminants ☐

93. The singular solution(s) of the differential equation

$$4xp^2=(3x-a)^2$$

is/are given by

- (a) $x=0$ only ☐
 (b) $3x-a=0$ only ☐
 (c) $x-a=0$ only ☐
 (d) $x=0, 3x-a=0$ and $x-a=0$ ☐

94. The differential equation $p^2+y^2=1$ has how many singular solutions?

- (a) None ☐
 (b) One ☐
 (c) Two ☐
 (d) Three ☐

95. The differential equation

$$p^2(1-x^2)=1-y^2$$

has how many singular solutions?

- (a) 1 ☐
 (b) 2 ☐
 (c) 3 ☐
 (d) 4 ☐

96. The singular solution(s) of the differential equation

$$dy\sqrt{x}+dx\sqrt{y}$$

is/are given by

- (a) $x=0$ only ☐
 (b) $y=0$ only ☐
 (c) Both of the above ☐
 (d) None of the above ☐

97. The singular solution(s) of the differential equation

$$8ap^3=27$$

is/are given by

- (a) $y=0$ only ☐
 (b) $x=0$ only ☐
 (c) $y=a$ only ☐
 (d) $x=0$ and $y=0$ ☐

98. The general solution of the differential equation

$$(a^2-x^2)p^2+2xyp+(b^2-y^2)=0$$

represents a family of straight lines whose envelope is the

- (a) Hyperbola ☐
 (b) Parabola ☐
 (c) Ellipse ☐
 (d) Circle ☐

99. The Euler's method provides the solution of which of the following first order differential equations?

- (a) $\frac{dy}{dx}=g(x)$ only ☐
 (b) $\frac{dy}{dx}=k(y)$ only ☐
 (c) $\frac{dy}{dx}=g(x) \cdot k(y)$ only ☐
 (d) $\frac{dy}{dx}=f(x, y)$ ☐

100. Euler's method for solving a differential equation of the type

$$\frac{dy}{dx}=f(x, y)$$

provides

- (a) An approximate solution in general ☐
 (b) Always an exact solution ☐
 (c) An exact solution only when the differential equation is of the type ☐

$$\frac{dy}{dx} = h(y) \text{ or } g(x)$$

(d) None of the above

101. The solution of the differential equation $\frac{dy}{dx} = f(x, y)$ through a given point (x_0, y_0) can be written as $y = F(x)$. The Euler's method determines discrete points on the solution curve $y = F(x)$. Let (x_1, y_1) be first point calculated and let $(y')_0$ denote the value of $\frac{dy}{dx}$ at (x_0, y_0) . Then

(a) $y_1 \approx (y')_0 (x_1 - x_0)$

(b) $y_1 \approx x_0 + (y')_0 (x_1 - x_0)$

(c) $y_1 \approx y_0 + (y')_0 (x_1 - x_0)$

(d) None of the above is true

102. Let (x_2, y_2) be the second point calculated by the Euler's method on the solution curve $y = F(x)$. Then

(a) $y_2 = y_1 + (y')_1 (x_2 - x_1)$

(b) $y_2 = y_1 + [(y')_0 + (y')_1] (x_2 - x_1)$

(c) $y_2 = y_0 + (y')_0 (x_2 - x_1)$

(d) $y_2 = y_0 + (y')_0 (x_2 - x_0)$

103. Let the solution of the differential equation $\frac{dy}{dx} = x + y$ pass through $(0, 1)$ and let $(0.5, y_1)$ be the first point calculated on the solution curve by the Euler's method. Then y_1 is equal to

(a) 1

(b) 0.5

(c) 1.05

(d) -0.05

104. Consider the differential equation

$$a_0 \frac{d^2 y}{dx^2} + a_1 \frac{dy}{dx} + a_2 y = f(x)$$

This will be differential equation with constant coefficients if

(a) a_0, a_1, a_2 and f are all constants

(b) f is constant

(c) a_0, a_1, a_2 are constants

(d) a_0 is constant

105. The differential equation

$$a_0 \frac{d^2 y}{dx^2} + a_1 \frac{dy}{dx} + a_2 y = f$$

is said to be homogeneous if

(a) $f = 0$ or 1

(b) $f = 0$

(c) $f = 1$

(d) $f = \text{constant}$

106. The general solution of the differential equation

$$D^n y + a_1 D^{n-1} y + a_2 D^{n-2} y + \dots + a_n y = X$$

of n th order, where X is a function of x alone and $a_1, a_2, \dots, a_n$ are constants, is given by

$$y = \text{Complementary Function (C.F.)} + \text{Particular Integral (P.I.)}$$

Then

(a) C.F. involves no arbitrary constant but the P.I. involves n arbitrary constants.

(b) C.F. involves n arbitrary constants but P.I. may or may not involve any arbitrary constant

(c) C.F. involves n arbitrary constants but P.I. does not involve any

(d) C.F. and P.I. both involve atleast one arbitrary constant.

107. The auxiliary equation

$$a_0 D^2 + a_1 D + a_2 = 0$$

is obtained from the linear differential equation

$$a_0 \frac{d^2 y}{dx^2} + a_1 \frac{dy}{dx} + a_2 y = 0,$$

where a_0, a_1, a_2 are constants, by substituting

(a) $y = x^m$

(b) $y = e^{mx}$

(c) $y = \sin mx$

(d) $y = \cos mx$

108. The auxiliary equation of the differential equation

$$\frac{d^2 y}{dx^2} + 3 \frac{dy}{dx} + 4y = 0$$

is

(a) $D^2 + 3D + 4 = 0$

(b) $4D^2 + 3D + 1 = 0$

(c) $D^2 + D + 1 = 0$

(d) $D^2 + D = 0$

109. The general solution of the linear differential equation

$$\frac{d^4 y}{dx^4} - 81y = 0$$

is given by

- (a) $c_1 e^{3x} + c_2 e^{-3x} + e^x [c_3 \cos 3x + c_4 \sin 3x]$ ☐
 (b) $(c_1 + c_2 x) e^{3x} + c_3 \cos 3x + c_4 \sin 3x$ ☐
 (c) $c_1 e^{3x} + c_2 e^{-3x} + c_3 \cos 3x + c_4 \sin 3x$ ☐
 (d) $c_1 e^{3x} + c_2 e^{-3x} + e^{3x} [c_3 \cos x + c_4 \sin x]$ ☐

110. If m_1 and m_2 are the roots of the auxiliary equation of the given linear differential equation of second order with constant coefficients, then

- (a) m_1 and m_2 are always real and distinct ☐
 (b) m_1 and m_2 are always complex ☐
 (c) m_1 and m_2 , both may be complex and equal ☐
 (d) m_1 and m_2 both may be real and equal, real and distinct or complex ☐

111. If the roots of the auxiliary equation corresponding to the differential equation

$$a_0 \frac{d^2 y}{dx^2} + a_1 \frac{dy}{dx} + a_2 y = 0$$

be m_1 and m_2 such that m_1 and m_2 are both real and distinct, then the general solution of the given equation is

$$y = c_1 e^{m_1 x} + c_2 e^{m_2 x}, \text{ where}$$

- (a) c_1 and c_2 are both negative constants ☐
 (b) c_1 and c_2 are any arbitrary constants ☐
 (c) c_1 and c_2 are of opposite signs ☐
 (d) c_1 and c_2 are of the same sign ☐

112. If the roots m_1 and m_2 of the auxiliary equation with constant coefficients are equal i.e. $m_1 = m_2 = m$, then the general solution is given by

- (a) $y = m_1 e^{m_1 x} + m_2 e^{m_2 x}$ ☐
 (b) $y = (c_1 + x c_2) e^{mx}$ ☐
 (c) $y = c_1 e^{mx} + c_2 e^{mx}$ ☐
 (d) $y = (c_1 x + c_2 x^2) e^{mx}$ ☐

113. If the roots m_1 and m_2 of the auxiliary equation corresponding to the given differential equation

$$a_0 \frac{d^2 y}{dx^2} + a_1 \frac{dy}{dx} + a_2 y = 0$$

are of the type $\alpha + i\beta$ and $\alpha - i\beta$ respectively, then the general solution of the differential equation is given by

- (a) $y = e^{\alpha x} [c_1 \cos \beta x + c_2 \sin \beta x]$ ☐
 (b) $y = e^{\beta x} [c_1 \sin \alpha x + c_2 \cos \alpha x]$ ☐
 (c) $y = e^{-\beta x} [c_1 \cos \alpha x + c_2 \sin \alpha x]$ ☐
 (d) $y = e^{\alpha x} [c_1 e^{\beta x} + c_2 e^{-\beta x}]$ ☐

114. The solution of the initial value problem

$$\frac{d^2 y}{dx^2} - 6 \frac{dy}{dx} + 8y = 0$$

$$(y)_{x=0} = 0$$

$$\left(\frac{dy}{dx} \right)_{x=0} = 0$$

is given by

- (a) $y = \frac{1}{2} (e^{4x} + e^{2x})$ ☐
 (b) $y = \frac{1}{2} (e^{4x} - e^{2x})$ ☐
 (c) $y = \frac{1}{2} (e^{2x} - e^{4x})$ ☐
 (d) None of the above ☐

115. The particular solution of the given differential equation

$$\frac{d^2 y}{dx^2} - 2 \frac{dy}{dx} + 2y = e^x \text{ is given by}$$

- (a) e^x ☐
 (b) $\frac{1}{2} e^x$ ☐
 (c) $\frac{1}{3} e^x$ ☐
 (d) Does not exist ☐

116. The particular integral of the given differential equation

$$\frac{d^2 y}{dx^2} - 13 \frac{dy}{dx} + 12y = 36$$

is given by

- (a) 6 ☐
 (b) 3 ☐
 (c) e^{3x} ☐
 (d) $\frac{-36}{13}$ ☐

117. Consider the differential equation $f(D)y=e^{ax}$ where $f(a)=0$ and $f(D)=0$ is the corresponding auxiliary equation then

- (a) A particular integral may or may not be obtained ☐
 (b) No particular integral can be obtained ☐
 (c) A particular integral can always be obtained ☐
 (d) None of the above is true in this case ☐

118. The particular integral of the given differential equation $f(D^2)y=\sin ax$ is given by

- (a) $y = \frac{\sin ax}{f(a^2)}$ if $f(a^2) \neq 0$ ☐
 (b) $y = \frac{\sin ax}{f(-a^2)}$ if $f(-a^2) \neq 0$ ☐
 (c) $y = \frac{\sin ax}{f(a)}$ if $f(a) \neq 0$ ☐
 (d) $y = \frac{\cos ax}{f(a)}$ if $f(a) \neq 0$ ☐

119. $\frac{1}{D-a} Q(x) =$

- (a) $e^{ax} \int Q(x) dx$ ☐
 (b) $e^{-ax} \int Q(x) dx$ ☐
 (c) $e^{ax} \int e^{-ax} Q(x) dx$ ☐
 (d) $e^{-ax} \int e^{ax} Q(x) dx$ ☐

120. $\frac{e^{ax}}{(D-a)^2}$ is equal to

- (a) $x^2 e^{ax}$ ☐
 (b) $\frac{x^2}{2} e^{ax}$ ☐
 (c) $x^2 e^{-ax}$ ☐
 (d) $x e^{-ax}$ ☐

121. The particular integral corresponding to the given differential equation

$$\frac{d^2 y}{dx^2} - 3 \frac{dy}{dx} + 2y = e^x$$

is given by

- (a) $x e^x$ ☐
 (b) $\frac{1}{6} e^x$ ☐
 (c) e^x ☐

(d) $-x e^x$ ☐

122. The particular integral of the differential equation

$$\frac{d^2 y}{dx^2} - 2 \frac{dy}{dx} + y = \cos 3x$$

is given by

- (a) $-\frac{3}{25} \sin 3x$ ☐
 (b) $-\frac{3}{25} \cos 3x$ ☐
 (c) $\frac{1}{25} [-3 \sin 3x - 4 \cos 3x]$ ☐
 (d) $-\frac{1}{25} [3 \sin 3x - 4 \cos 3x]$ ☐

123. What is the particular integral of the differential equation

$$\frac{d^2 y}{dx^2} + a^2 y = \sin ax ?$$

- (a) $-\frac{x}{2a} \sin ax$ ☐
 (b) $-\frac{x}{2a} \cos ax$ ☐
 (c) $\frac{x}{2a} \sin ax$ ☐
 (d) $\frac{x}{2a} \cos ax$ ☐

124. If the differential equation is of the type $f(D)y=\sin ax$ where $f(D)$ is a polynomial in D containing the odd powers in D only, then

- (a) A particular integral can always be obtained ☐
 (b) No particular integral can be obtained ☐
 (c) Particular integral in this case is taken as constant ☐
 (d) Particular integral is given by $\frac{\sin ax}{f(-a^2)}$ if $f(-a^2) \neq 0$ ☐

125. The particular integral of the differential equation $(D^2-4)y=\sin 4x$ is given by

- (a) $y = \frac{x \sin 4x}{20}$ ☐
 (b) $y = \frac{-\sin 4x}{20}$ ☐

$$(c) y = \frac{-x \cos 4x}{8}$$

$$(d) y = \frac{-x \cos 4x}{20}$$

126. The particular integral of the differential equation

$(D^2+9)y = \cos 2x + \sin 2x$ is given by

$$(a) y = \frac{1}{13}(\cos 2x + \sin 2x)$$

$$(b) y = \frac{1}{25}(\cos 2x + \sin 2x)$$

$$(c) y = \frac{1}{5}(\cos 2x + \sin 2x)$$

$$(d) y = \frac{1}{13}(\cos 2x - \sin 2x)$$

127. The general solution of the differential equation

$$\frac{d^2y}{dx^2} + \frac{dy}{dx} - 6y = x \text{ is given by}$$

$$(a) y = c_1 e^{3x} + c_2 e^{-2x} - \frac{6x+1}{36}$$

$$(b) y = c_1 e^{-3x} + c_2 e^{2x} - \frac{x}{6} - \frac{1}{36}$$

$$(c) y = c_1 e^{-3x} + c_2 e^{2x} + \frac{x}{6} + \frac{1}{36}$$

$$(d) y = c_1 e^{3x} + c_2 e^{-2x} + \frac{x}{6} + \frac{1}{36}$$

128. The particular integral of the differential equation

$$\frac{d^2y}{dx^2} + 2 \frac{dy}{dx} + 5y = xe^x$$

is given by

$$(a) -\frac{e^x}{16}(2x+1)$$

$$(b) \frac{e^x}{16}(x+1)$$

$$(c) -\frac{e^x}{8}(2x-1)$$

$$(d) \frac{e^x}{16}\left(x - \frac{1}{2}\right)$$

129. The particular integral of the differential equation

$$\frac{d^2y}{dx^2} - 6 \frac{dy}{dx} + 13y = 8e^{3x} \sin 2x$$

is given by

$$(a) -\frac{1}{2}xe^{3x} \sin 2x$$

$$(b) -\frac{1}{2}xe^{3x} \cos 2x$$

$$(c) \frac{1}{2}xe^{-3x} \sin 2x$$

$$(d) \frac{1}{2}xe^{-3x} \cos 2x$$

130. The particular integral of the differential equation

$$(D^2 - 2D + 1)y = xe^x \sin x$$

is given by

$$(a) e^x(x \cos x + \sin x)$$

$$(b) x(e^x \cos x + \sin x)$$

$$(c) e^x \sin x(x+1)$$

$$(d) -e^x(x \sin x + 2 \cos x)$$

131. The differential equation of the type

$$x^n \frac{d^n y}{dx^n} + a_1 x^{n-1} \frac{d^{n-1} y}{dx^{n-1}}$$

$$+ \dots + a_n y = X,$$

where X is either a constant or a function of x only, is

$$(a) \text{ Linear but not homogeneous.}$$

$$(b) \text{ Homogeneous but not linear}$$

$$(c) \text{ Both homogeneous and linear}$$

$$(d) \text{ Neither linear nor homogeneous}$$

132. A differential equation of the type

$$x^n \frac{d^n y}{dx^n} + a_1 x^{n-1} \frac{d^{n-1} y}{dx^{n-1}}$$

$$+ \dots + a_n y = X,$$

where $a_1, a_2, \dots, a_n$ are constants and X is either a constant or a function of x , is also called

$$(a) \text{ Lagrange's equation}$$

$$(b) \text{ Cauchy's Euler equation}$$

$$(c) \text{ Bernoulli's equation}$$

$$(d) \text{ Legendre's equation}$$

133. The differential equation

$$x^n \frac{d^n y}{dx^n} + a_1 x^{n-1} \frac{d^{n-1} y}{dx^{n-1}}$$

$+ \dots + a_n y = 0$ can be transformed into a linear differential equation with constant coefficients by means of the substitution

$$(a) z = \log x$$

$$(b) x = \log z$$

(c) $x=e^{-z}$ ☐

(d) $x=\frac{1}{z}$ ☐

134. Which one of the following differential equations is equivalent to the differential equation

$$x^2 \frac{d^2 y}{dx^2} - x \frac{dy}{dx} + 2y = x \log x ?$$

(a) $\frac{d^2 y}{dx^2} - \frac{dy}{dx} + 2y = z \log z$ ☐

(b) $\frac{d^2 y}{dx^2} - 2 \frac{dy}{dx} + 4y = -\frac{1}{z} \log z$ ☐

(c) $\frac{d^2 y}{dx^2} - 3 \frac{dy}{dx} + 2y = e^z$ ☐

(d) $\frac{d^2 y}{dx^2} - 2 \frac{dy}{dx} + 2y = ze^z$ ☐

135. The initial value problem

$$\frac{dy}{dx} = x, y(0)=1 \text{ has}$$

(a) Only one solution ☐

(b) Two solutions ☐

(c) No solution ☐

(d) An infinite number of solutions ☐

136. The initial value problem

$$\frac{dy}{dx} = \frac{y-1}{x}, y(0)=1$$

has

(a) Only one solution ☐

(b) An infinite number of solutions ☐

(c) No solution ☐

(d) Either one or two solutions ☐

137. The linear differential equation of order n

$$P_0 \frac{d^n y}{dx^n} + P_1 \frac{d^{n-1} y}{dx^{n-1}} + \dots$$

$$+ P_n(y) = Q(x),$$

where $P_0, P_1, \dots, P_n$ and Q are functions of x alone, is exact if

(a) $P_n - P'_{n-1} + P''_{n-2} + \dots - P_0^n = 0$ ☐

(b) $P_n - P'_{n-1} + P''_{n-2} + \dots + P_0^n = 0$ ☐

(c) $P_n - P'_{n-1} + P''_{n-2} + \dots + (-1)^n P_0^n = 0$ ☐

(d) $P_n - P'_{n-1} + P''_{n-2} + \dots + (-1)^{n-1} P_0^n = 0$ ☐

138. Which of the following differential equations is not exact ?

(a) $\sin x \frac{d^2 y}{dx^2} - \cos x \frac{dy}{dx} + 2y \sin x = 0$ ☐

(b) $\sin^2 x \frac{d^2 y}{dx^2} = 2y$ ☐

(c) $\sqrt{x} \frac{d^2 y}{dx^2} + 2x \frac{dy}{dx} + 3y = x$ ☐

(d) $\frac{d^2 y}{dx^2} = 2y \sec^2 x$ ☐

139. The first integral of the differential equation

$$P_0 \frac{d^3 y}{dx^3} + P_1 \frac{d^2 y}{dx^2} + P_2 \frac{dy}{dx} + P_3 = 0,$$

where P_0, P_1, P_2 and P_3 are functions of x , is given by

(a) $P_0 \frac{d^2 y}{dx^2} + (P_1 - P_0') \frac{dy}{dx} + (P_2 - P_1' + P_0'') y = \text{const}$ ☐

(b) $P_0 \frac{d^2 y}{dx^2} + (P_1 - P_0) \frac{dy}{dx} + (P_2 - P_1 + P_0) y = \text{const}$ ☐

(c) $P_0 \frac{d^2 y}{dx^2} + (P_0 + P_1) \frac{dy}{dx} + (P_0 + P_1 + P_2) y = \text{const}$ ☐

(d) None of the above ☐

140. The first integral of the differential equation

$$(1+x^2) \frac{d^2 y}{dx^2} + 3x \frac{dy}{dx} + y = 0$$

is given by

(a) $(1+x^2) \frac{dy}{dx} + 3xy = \text{const}$ ☐

(b) $2x \frac{dy}{dx} + 3y = \text{const}$ ☐

(c) $x^2 \frac{dy}{dx} + xy = \text{const}$ ☐

(d) $(1+x^2) \frac{dy}{dx} + xy = \text{const}$ ☐

141. The first integral of the differential equation

$$P_0 \frac{d^2y}{dx^2} + P_1 \frac{dy}{dx} + P_2 y = Q(x)$$

is given by

(a) $P_0 \frac{dy}{dx} + (P_1 - P_0')y = C_1$ ☐

(b) $P_0 \frac{dy}{dx} + (P_1 - P_0')y = \int Q(x)dx + C_1$ ☐

(c) $P_0 \frac{dy}{dx} + P_1 y = \int Q(x)dx + C_1$ ☐

(d) None of the above ☐

ANSWERS

- | | | | | | |
|-------|-------|-------|--------|--------|--------|
| 1. c | 2. b | 3. c | 73. d | 74. a | 75. a |
| 4. a | 5. b | 6. d | 76. c | 77. a | 78. b |
| 7. b | 8. c | 9. b | 79. b | 80. d | 81. a |
| 10. a | 11. a | 12. d | 82. c | 83. c | 84. b |
| 13. c | 14. a | 15. b | 85. b | 86. d | 87. c |
| 16. c | 17. d | 18. d | 88. b | 89. d | 90. c |
| 19. c | 20. c | 21. a | 91. b | 92. b | 93. a |
| 22. b | 23. d | 24. d | 94. c | 95. d | 96. c |
| 25. c | 26. b | 27. c | 97. a | 98. c | 99. d |
| 28. b | 29. a | 30. c | 100. a | 101. c | 102. a |
| 31. c | 32. d | 33. a | 103. c | 104. c | 105. b |
| 34. b | 35. c | 36. c | 106. c | 107. b | 108. a |
| 37. d | 38. a | 39. a | 109. c | 110. d | 111. b |
| 40. b | 41. c | 42. b | 112. b | 113. a | 114. b |
| 43. a | 44. b | 45. a | 115. a | 116. b | 117. c |
| 46. d | 47. c | 48. a | 118. b | 119. c | 120. b |
| 49. d | 50. c | 51. a | 121. d | 122. c | 123. b |
| 52. a | 53. a | 54. a | 124. a | 125. b | 126. c |
| 55. b | 56. c | 57. b | 127. b | 128. a | 129. b |
| 58. b | 59. a | 60. a | 130. d | 131. c | 132. b |
| 61. b | 62. a | 63. b | 133. a | 134. d | 135. a |
| 64. b | 65. c | 66. a | 136. b | 137. c | 138. c |
| 67. c | 68. d | 69. a | 139. a | 140. d | 141. b |
| 70. c | 71. d | 72. d | | | |

Geometry

Section—A

TWO DIMENSIONAL GEOMETRY

1. Let the coordinate axes be inclined at an angle θ . Then the distance between two points $P(x_1, y_1)$ and $Q(x_2, y_2)$ is given by

(a) $\sqrt{[(x_1 - x_2)^2 + (y_1 - y_2)^2] \cos \theta}$ ☐

(b) $\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2 + 2(x_1 - x_2)(y_1 - y_2) \cos \theta}$ ☐

(c) $\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2 + 2(x_1 - x_2)(y_1 - y_2) \cos \theta}$ ☐

(d) $\sqrt{[(x_1 - x_2)^2 + (y_1 - y_2)^2 + 2(x_1 - x_2)(y_1 - y_2) \cos \theta]^{3/2}}$ ☐

2. The point equidistant from $(0, 0)$, $(32, 10)$, $(42, 0)$ is

(a) $(21, 11)$ ☐

(b) $(11, 21)$ ☐

(c) $(-21, -11)$ ☐

(d) $(21, -11)$ ☐

3. The points $(0, -1)$, $(-2, 3)$, $(6, 7)$, $(8, 3)$ form a

(a) Rectangle ☐

(b) Square ☐

(c) Trapezium ☐

(d) Quadrilateral ☐

4. If (x, y) is a point equidistant from $(3, 4)$ and $(1, -2)$, then

(a) $x + 7y = 7$ ☐

(b) $x - 2y = -1$ ☐

(c) $x + 3y = 5$ ☐

(d) None of the above ☐

5. The coordinates of point $P(x, y)$ dividing the line segment joining two points $A(x_1, y_1)$ and $B(x_2, y_2)$ in the ratio $m : n$ are given by

(a) $mx_2 + nx_1$ and $my_2 + ny_1$ ☐

(b) $\frac{nx_2 + mx_1}{n + m}$ and $\frac{ny_2 + my_1}{n + m}$ ☐

(c) $\frac{mx_2 + nx_1}{m - n}$ and $\frac{my_2 + ny_1}{m - n}$ ☐

(d) $\frac{mx_2 + nx_1}{m + n}$ and $\frac{my_2 + ny_1}{m + n}$ ☐

6. The coordinates of a point $P(x, y)$ which divides the line segment joining $A(x_1, y_1)$ and $B(x_2, y_2)$ externally in the ratio $m : n$, are given by

(a) $mx_2 - nx_1$ and $my_2 - ny_1$ ☐

(b) $\frac{mx_2 - nx_1}{m - n}$ and $\frac{my_2 - ny_1}{m - n}$ ☐

(c) $\frac{mx_2 - nx_1}{n - m}$ and $\frac{my_2 - ny_1}{n - m}$ ☐

(d) $\frac{nx_1 - mx_2}{n - m}$ and $\frac{ny_1 - my_2}{n - m}$ ☐

7. The centroid of a triangle is

(a) The intersection of the right bisectors of its angles ☐

(b) The intersection of the right bisectors of its sides ☐

(c) The intersection of its medians ☐

(d) The intersection of the perpendiculars drawn from its vertices on opposite sides. ☐

8. The centroid of the triangle, whose vertices are $(3, -5)$, $(-7, 4)$, $(10, -2)$, is given by

(a) $(6, -3)$ ☐

(b) $(2, -1)$ ☐

(c) $(3, -3/2)$ ☐

(d) All of the above. ☐

9. The point dividing the join of (2, 1) and (3, 5) externally in the ratio 2 : 3 is given by

- (a) (0, -7) ☐
 (b) (-12, -13) ☐
 (c) $\left(\frac{12}{5}, \frac{13}{5}\right)$ ☐
 (d) (12, 13) ☐

10. The area of a triangle with vertices (x_1, y_1) , (x_2, y_2) and (x_3, y_3) is given by

- (a) $\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$ ☐
 (b) $\frac{1}{2} \begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$ ☐
 (c) $\frac{1}{2} \begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & -1 \\ x_3 & y_3 & 1 \end{vmatrix}$ ☐
 (d) None of the above ☐

11. The area of a quadrilateral, whose vertices are given by (x_1, y_1) , (x_2, y_2) , (x_3, y_3) and (x_4, y_4) respectively, is

- (a) $\frac{1}{2}\{x_1y_2+x_2y_1+x_2y_3+x_3y_2+x_3y_4+x_4y_3+x_4y_1+x_1y_4\}$ ☐
 (b) $\frac{1}{2}\{(x_1y_2-x_2y_1)+(x_2y_3-x_3y_2)+(x_3y_4-x_4y_3)+(x_4y_1-x_1y_4)\}$ ☐
 (c) $\frac{1}{4}\{(x_1y_2-x_2y_1)+(x_2y_3-x_3y_2)+(x_3y_4-x_4y_3)+(x_4y_1-x_1y_4)\}$ ☐
 (d) $\frac{1}{8}\{(x_1y_2+x_2y_1)-(x_2y_3+x_3y_2)+(x_3y_4+x_4y_3)-(x_4y_1+x_1y_4)\}$ ☐

12. The area of the quadrilateral ABCD with coordinates of A, B, C and D as (-4, 2), (3, -5), (1, 7) and (6, -2) respectively is

- (a) 0 ☐
 (b) 56 ☐
 (c) 28 ☐
 (d) None of the above ☐

13. The system of coordinates known as the cartesian system of coordinates was first introduced by

- (a) Euclid ☐
 (b) Euler ☐

- (c) Des Cartes ☐
 (d) Tartaglia ☐

14. The distance between two points, whose coordinates are given by (r_1, θ_1) and (r_2, θ_2) respectively, is given by

- (a) $\sqrt{r_1^2+r_2^2-2r_1r_2}$ ☐
 (b) $\sqrt{(r_1-\theta_1)^2+(r_2-\theta_2)^2}$ ☐
 (c) $\sqrt{r_1^2+r_2^2+2r_1r_2 \sin(\theta_1-\theta_2)}$ ☐
 (d) $\sqrt{r_1^2+r_2^2-2r_1r_2 \cos(\theta_1-\theta_2)}$ ☐

15. The polar equation of a circle with radius c and centre (a, α) is given by

- (a) $r^2=a^2+c^2+2ar \cos \alpha$ ☐
 (b) $r^2=c^2-a^2+2ar \cos(\theta-\alpha)$ ☐
 (c) $r^2=c^2-a^2-2ar \cos \theta$ ☐
 (d) $r^2=c^2+a^2+2ar \cos(\theta-\alpha)$ ☐

16. The rectangular coordinates of the point $(-4, -\pi/4)$ are

- (a) $(2\sqrt{2}, 2\sqrt{2})$ ☐
 (b) $(-2\sqrt{2}, 2\sqrt{2})$ ☐
 (c) $(\sqrt{2}, -2)$ ☐
 (d) $(-\sqrt{2}, 2\sqrt{2})$ ☐

17. The polar coordinates of the point (3, -4) are

- (a) $(5, \tan^{-1} \frac{3}{4})$ ☐
 (b) $(\sqrt{7}, -\tan^{-1} \frac{4}{3})$ ☐
 (c) $(5, -\tan^{-1} \frac{4}{3})$ ☐
 (d) $(-\sqrt{7}, \tan^{-1} \frac{3}{4})$ ☐

18. The distance between the points whose polar coordinates are $(2, 40^\circ)$ and $(4, 100^\circ)$ respectively, is

- (a) 12 ☐
 (b) $2\sqrt{3}$ ☐
 (c) $2\sqrt{7}$ ☐
 (d) 28 ☐

19. The locus of a point whose distance is 3 from the point $(5, \frac{\pi}{2})$ is given by

- (a) $r^2-10r \sin \theta+16=0$ ☐
 (b) $r^2-5r \sin \theta+22=0$ ☐
 (c) $r^2-10r \cos \theta-2=0$ ☐
 (d) $r^2-10 \sin \theta+16=0$ ☐

20. Let ABC be any triangle. Let D, E, F , be the mid-points of the sides BC, CA, AB respectively. Then

- (a) $\triangle ABC = \triangle DEF$ ☐
 (b) $\triangle ABC = 2\triangle DEF$ ☐
 (c) $\triangle ABC = 4\triangle DEF$ ☐
 (d) $\triangle ABC = \frac{1}{2}\triangle DEF$ ☐

21. The area of a triangle whose vertices are given by $A(r_1, \theta_1), B(r_2, \theta_2)$ and $C(r_3, \theta_3)$ respectively, is given by

- (a) $\frac{1}{2}\{r_1r_2 \sin(\theta_1 - \theta_2) + r_2r_3 \sin(\theta_2 - \theta_3) + r_3r_1 \sin(\theta_3 - \theta_1)\}$ ☐
 (b) $\frac{1}{2}\{r_1r_2 \sin(\theta_2 - \theta_1) + r_2r_3 \sin(\theta_3 - \theta_2) + r_3r_1 \sin(\theta_1 - \theta_3)\}$ ☐
 (c) $\frac{1}{2}\{r_1r_2 \sin(\theta_2 - \theta_1) + r_1r_3 \sin(\theta_2 - \theta_3) + r_3r_1 \sin(\theta_1 - \theta_3)\}$ ☐
 (d) $\frac{1}{2}\{r_1r_2 \sin(\theta_2 - \theta_1) + r_2r_3 \sin(\theta_3 - \theta_2) + r_3r_1 \sin(\theta_3 - \theta_1)\}$ ☐

22. The area of a quadrilateral, the polar coordinates of whose vertices are given by $A(r_1, \theta_1), B(r_2, \theta_2), C(r_3, \theta_3)$ and $D(r_4, \theta_4)$, are given by

- (a) $\frac{1}{2}\{r_1r_2 \sin(\theta_2 - \theta_1) + r_2r_3 \sin(\theta_3 - \theta_2) + r_3r_4 \sin(\theta_4 - \theta_3) + r_4r_1 \sin(\theta_1 - \theta_4)\}$ ☐
 (b) $\frac{1}{2}\{r_1r_2 \sin(\theta_1 - \theta_2) + r_2r_3 \sin(\theta_3 - \theta_2) + r_3r_4 \sin(\theta_4 - \theta_3) + r_4r_1 \sin(\theta_1 - \theta_4)\}$ ☐
 (c) $\frac{1}{2}\{r_1r_2 \sin(\theta_2 - \theta_1) + r_2r_3 \sin(\theta_2 - \theta_3) + r_3r_4 \sin(\theta_4 - \theta_3) + r_4r_1 \sin(\theta_1 - \theta_4)\}$ ☐
 (d) $\frac{1}{2}\{r_1r_2 \sin(\theta_2 - \theta_1) + r_2r_3 \sin(\theta_3 - \theta_2) + r_3r_4 \sin(\theta_3 - \theta_4) + r_4r_1 \sin(\theta_1 - \theta_4)\}$ ☐

23. The equation of a straight line which makes an angle of 90° with the positive direction of the x -axis and passes through the origin is given by

- (a) $x=0$ ☐
 (b) $y=0$ ☐
 (c) $x=c$ ☐
 (d) $y=c$ ☐

24. The equation of the straight line which makes an angle of 135° with the positive direction of the x -axis and cuts off an intercept equal to 5 on y -axis, is given by

- (a) $y+x-5=0$ ☐
 (b) $y=x+5$ ☐

(c) $y=\frac{1}{2}x+5$ ☐

(d) $y=5$ ☐

25. Which of the following polar coordinates are associated to the same point?

I : $(2, 30^\circ)$, II : $(3, 150^\circ)$, III : $(-2, 45^\circ)$
 IV : $(-3, 330^\circ)$, V : $(3, -210^\circ)$, VI : $(-3, 30^\circ)$

- (a) I, III and V ☐
 (b) II, IV and VI ☐
 (c) II, IV, V and VI ☐
 (d) IV and VI only ☐

26. Let p be the perpendicular from the origin on a straight line and α be the angle which this perpendicular makes with the positive direction of the axis of x , then the straight line cuts of an intercept equal to—on y -axis

- (a) $p \operatorname{cosec} \alpha$ ☐
 (b) $-p \cot \alpha$ ☐
 (c) $p \sin \alpha$ ☐
 (d) $p \tan \alpha$ ☐

27. Which of the following statements is correct?

- (a) An equation of first degree always represents a straight line ☐
 (b) An equation of first degree may or may not represent a straight line ☐
 (c) Every equation of odd degree always represents a straight line ☐
 (d) An equation of the type

$$\frac{x}{a} + \frac{y}{b} = 1$$

only represents a straight line, where a and b are the intercepts made by the straight line on x -axis and y -axis respectively ☐

28. The length of the perpendicular from the origin on the line $Ax + By + C = 0$ is given by

- (a) $\frac{C}{\sqrt{A^2 + B^2}}$ ☐
 (b) $\frac{-C}{A^2 + B^2}$ ☐
 (c) $\frac{-C}{\sqrt{A^2 + B^2}}$ ☐
 (d) $-\sqrt{\frac{C}{A^2 + B^2}}$ ☐

29. The equation of the straight line which makes equal intercepts on the coordinate axis and passes through the point (2, 3), is given by

- (a) $x+y=5$ ☐
 (b) $2x+3y=5$ ☐
 (c) $x+y=2$ ☐
 (d) $x+y=3$ ☐

30. The length of the perpendicular from the origin on the straight line

$$5x+12y-26=0,$$

is given by

- (a) $\frac{676}{169}$ ☐
 (b) $\frac{26}{169}$ ☐
 (c) -2 ☐
 (d) 2 ☐

31. The equation of a straight line which makes an angle of 60° with x -axis and passes through the point $(\sqrt{3}, 2)$, is given by

- (a) $y=\sqrt{3}x+1$ ☐
 (b) $\sqrt{3}x-y=1$ ☐
 (c) $x-\sqrt{3}y=\sqrt{3}$ ☐
 (d) $x-\sqrt{2}y=\sqrt{2}$ ☐

32. The line $y-x+2=0$ cuts the line joining (3, -1) and (8, 9) in the ratio

- (a) 3 : 2 ☐
 (b) 2 : 3 ☐
 (c) 3 : -2 ☐
 (d) -3 : 2 ☐

33. The equation of the straight line passing through (4, 5) and parallel to the line $2x-3y=5$ is given by

- (a) $2x-3y=7$ ☐
 (b) $2x-3y=-7$ ☐
 (c) $3x-2y=7$ ☐
 (d) $3x-2y=-7$ ☐

34. The condition that the three straight lines

$$ax+by+c=0$$

$$a_1x+b_1y+c_1=0$$

$$\text{and } a_2x+b_2y+c_2=0$$

may meet in a point, is that the value of the determinant

$$\begin{vmatrix} a & b & c \\ a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \end{vmatrix} \quad \text{must be}$$

- (a) Zero ☐
 (b) Nonzero ☐
 (c) Either positive or zero ☐
 (d) Positive ☐

35. The point (x_1, y_1) lies on the positive side of the straight line

$$Ax+By+C=0 \quad \text{if}$$

- (a) $Ax_1+By_1+C>0$ ☐
 (b) $Ax_1+By_1+C<0$ ☐
 (c) $Ax_1+By_1>0$ ☐
 (d) $Ax_1+By_1<0$ ☐

36. The point (3, 2) lies on the

- (a) Negative side of the line $3x-2y-1=0$ and positive side of the line $2x-3y-1=0$ ☐
 (b) Negative sides of both the lines $3x-2y-1=0$ and $2x-3y-1=0$ ☐
 (c) Positive sides of both the lines $3x-2y-1=0$ and $2x-3y-1=0$ ☐
 (d) Positive side of the line $3x-2y-1=0$ and negative side of the line $2x-3y-1=0$ ☐

37. When two straight lines $2x-3y+1=0$ and $3x-5y+2=0$ are traced, we get four different compartments. Which of the following four points lie in the same compartment?

$$A(0, 0), B(-1, 1), C(-7, -4), D(9, 6).$$

- (a) A and B ☐
 (b) A and D ☐
 (c) B and C ☐
 (d) The points A, B, C and D all lie in different compartments ☐

38. The angle between the lines $ax+by+c=0$ and $a'x+b'y+c'=0$ is given by

- (a) $\tan^{-1} \frac{ba'+b'a}{aa'-bb'}$ ☐
 (b) $\tan^{-1} \frac{aa'-bb'}{ba'+ab'}$ ☐
 (c) $\tan^{-1} \frac{a'b-ab'}{aa'+bb'}$ ☐
 (d) All of the above ☐

39. The straight lines $ax+by+c=0$ and $a'x+b'y+c'=0$ are perpendicular if

- (a) $a'b=b'a$ ☐
 (b) $aa'=bb'$ ☐
 (c) $aa'=-bb'$ ☐
 (d) $\frac{a}{a'}=\frac{b}{b'}=\frac{c}{c'}$ ☐

40. The line passing through the origin is given by

- (a) $y-2x=-1$ ☐
 (b) $2y+4x=7$ ☐
 (c) $2y+4x=6$ ☐
 (d) None of the above ☐

41. The line joining (3, -1) and (2, 3)

- (a) Is perpendicular to the line joining (5, 2) and (9, 3). ☐
 (b) Makes an angle of 45° with the line joining (5, 2) and (9, 3) ☐
 (c) Is parallel to the line joining (5, 2) and (9, 3) ☐
 (d) None of the above ☐

42. The equation to the bisector of the angle between the lines $3x-4y+7=0$ and $12x-5y-8=0$, in which the origin lies, is given by

- (a) $21x+27y-131=0$ ☐
 (b) $99x-77y+51=0$ ☐
 (c) $21x-27y+131=0$ ☐
 (d) $99x+77y-51=0$ ☐

43. The line joining the origin to the point of intersection of

$$2x+5y-4=0 \text{ and } 3x-2y+2=0$$

is given by

- (a) $5x+3y=0$ ☐
 (b) $8x+y=0$ ☐
 (c) $x-7y=0$ ☐
 (d) $8x+9y=0$ ☐

44. The area of the triangle formed by the lines $y-x=0$, $y+x=0$, $x-c=0$ is given by

- (a) c ☐
 (b) c^2 ☐
 (c) $2c^2$ ☐
 (d) $\frac{c^2}{2}$ ☐

45. A homogeneous equation of n th degree represents

- (a) n straight lines passing through the origin ☐
 (b) At the most n straight lines passing through the origin ☐
 (c) At least one straight line passing through the origin ☐
 (d) n straight lines all of which either pass through origin or may not pass through the origin ☐

46. The angle between the two straight lines represented by the equation

$$Ax^2+2Bxy+Cy^2=0 \text{ is given by}$$

- (a) $\tan^{-1} \frac{\sqrt{B^2-AC}}{2A}$ ☐
 (b) $\tan^{-1} \frac{\sqrt{B^2-4AC}}{2A}$ ☐
 (c) $\tan^{-1} \frac{2\sqrt{B^2-AC}}{A+C}$ ☐
 (d) $\tan^{-1} \frac{2\sqrt{B^2+AC}}{A+C}$ ☐

47. The lines represented by the equation $Ax^2+2Bxy+Cy^2=0$ are real, coincident or imaginary according as B^2-AC is

- (a) Negative, zero or positive ☐
 (b) Zero, positive or negative ☐
 (c) Positive, negative or zero ☐
 (d) Positive, zero or negative ☐

48. The lines represented by the equation $Ax^2+2Bxy+Cy^2=0$ are perpendicular if

- (a) $A+2B=0$ ☐
 (b) $A+C=0$ ☐
 (c) $2B+C=0$ ☐
 (d) $B^2-AC=0$ ☐

49. The general equation of second degree $ax^2+2hxy+by^2+2gx+2fy+c=0$ may represent a pair of straight lines if

- (a) $af^2+bg^2+ch^2-2fgh=abc$ ☐
 (b) $af^2+bg^2+ch^2-fgh=2abc$ ☐
 (c) $af^2+bg^2+ch^2+2fgh+abc=0$ ☐
 (d) $af^2+bg^2+ch^2+fgh+2abc=0$ ☐

50. The lines joining the origin to the points of intersection of $2x^2+3xy-4x+1=0$ and $3x+y-1=0$ are given by

- (a) $x^2 + y^2 - 5xy = 0$ ☐
 (b) $x^2 - y^2 - 5xy = 0$ ☐
 (c) $x^2 + y^2 + 5xy = 0$ ☐
 (d) $x^2 - y^2 + 5xy = 0$ ☐

51. The equation of the straight lines bisecting the angles between the two straight lines

$$ax^2 + 2hxy + by^2 = 0$$

is given by

- (a) $h(x^2 - y^2) + xy(b - a) = 0$ ☐
 (b) $h(x^2 - y^2) - xy(b - a) = 0$ ☐
 (c) $(x^2 - y^2) = xy(a - b)$ ☐
 (d) $(x^2 + y^2) = xy(a - b)$ ☐

52. The polar equation of a straight line is given by—where p is the length of the perpendicular from the origin on the line

- (a) $r \sin(\theta - \alpha) = p$ ☐
 (b) $r \cos(\theta - \alpha) = p$ ☐
 (c) $r \tan(\theta - \alpha) = p$ ☐
 (d) $r = p \cos(\theta - \alpha)$ ☐

53. The polar equation of a line through two given points (r_1, θ_1) and (r_2, θ_2) is given by

- (a) $r_1 r_2 [\sin(\theta_2 - \theta_1) + \sin(\theta - \theta_2)] = 0$ ☐
 (b) $r_1 r_2 [\cos(\theta_2 - \theta_1) + \cos(\theta - \theta_2)] = 0$ ☐
 (c) $r_1 r_2 \sin(\theta_1 - \theta_2) + r_2 r \sin(\theta_2 - \theta) + r r_1 \sin(\theta - \theta_1) = 0$ ☐
 (d) None of the above ☐

54. If parallelograms are described, on the sides of a given triangle treating them as diagonals of the respective parallelograms having their sides parallel to two given straight lines, then the other diagonals of these parallelograms

- (a) Never meet in a point ☐
 (b) May or may not meet in a point ☐
 (c) Always meet in a point ☐
 (d) Meet on any one side of the triangle ☐

55. If the equations to a pair of opposite sides of a parallelogram are given by $x^2 - 7x + 6 = 0$ and $y^2 - 14y + 40 = 0$, then the equation to one of its diagonals is given by

- (a) $6x - 5y = 40$ ☐
 (b) $5y - 6x = 14$ ☐
 (c) $5y - 6x = 26$ ☐
 (d) None of the above. ☐

56. The equation $ax^2 + by^2 + c(x + y) = 0$ represents a pair of straight lines if

- (a) $c = 0$ ☐
 (b) $a + b = 0$ ☐
 (c) Either of the above ☐
 (d) None of above ☐

57. The equation of the straight line which passes through the point (x', y') and perpendicular to the straight line $yy' = 2a(x + x')$ is given by

- (a) $x'(y - y') + y'(x - x') = 0$ ☐
 (b) $a(y - y') + y'(x - x') = 0$ ☐
 (c) $2a(y - y') + y'(x - x') = 0$ ☐
 (d) $x'(y - y') + 2a(y - y') = 0$ ☐

58. The equation of the straight line passing through (x', y') and perpendicular to the straight line

$$\frac{xx'}{a^2} + \frac{yy'}{b^2} = 1, \text{ is given by}$$

- (a) $a^2 y' (x - x') - b^2 x' (y - y') = 0$ ☐
 (b) $a^2 y' (x - x') + b^2 x' (y - y') = 0$ ☐
 (c) $b^2 y' (x - x') - a^2 x' (y - y') = 0$ ☐
 (d) $b^2 y' (x - x') + a^2 x' (y - y') = 0$ ☐

59. The equations of straight lines passing through (x', y) and making an angle α with the given straight line $y = mx + c$, are given by

- (i) $y - y' = m \tan \alpha (x - x')$
 (ii) $y - y' = m \cot \alpha (x - x')$
 (iii) $y - y' = \frac{m - \tan \alpha}{1 + m \tan \alpha} (x - x')$
 (iv) $y - y' = \frac{m + \tan \alpha}{1 - m \tan \alpha} (x - x')$

- (a) (i) and (iii) ☐
 (b) (ii) and (iii) ☐
 (c) (iii) and (iv) ☐
 (d) (ii) and (iv) ☐

60. The equation to one of the straight lines passing through the point (h, k) and making an angle $\tan^{-1} m$ with the straight line $y = mx + c$ is given by

- (a) $y - k = \frac{m - \tan^{-1} m}{1 + m \tan^{-1} m} (x - h)$ ☐
 (b) $y - k = \frac{m + \tan^{-1} m}{1 - m \tan^{-1} m} (x - h)$ ☐
 (c) $x = h$ ☐
 (d) $y = k$ ☐

61. The diagonals of a parallelogram whose sides are given by

$\sqrt{3}x+y=0$, $\sqrt{3}y+x=0$, $\sqrt{3}x+y=1$,
 $\sqrt{3}y+x=1$, are inclined at an angle of---
 to one another

- (a) 45° ☐
 (b) 90° ☐
 (c) 60° ☐
 (d) 30° ☐

62. The distance between the two parallel straight lines

$y=mx+c$ and $y=mx+d$ is given by

- (a) $\frac{c-d}{\sqrt{1+m^2}}$ ☐
 (b) $\frac{c-d}{\sqrt{1-m^2}}$ ☐
 (c) $\frac{c+d}{\sqrt{1+m^2}}$ ☐
 (d) $\frac{c+d}{\sqrt{1-m^2}}$ ☐

63. Let ABC be a given triangle the coordinates of whose vertices are given by (x_1, y_1) , (x_2, y_2) and (x_3, y_3) respectively. Then the coordinates of the centre of the circle inscribed in it (where a, b, c , represent the sides BC, CA and AB respectively) are given by

- (a) $\frac{x_1+x_2+x_3}{3}, \frac{y_1+y_2+y_3}{3}$ ☐
 (b) $\frac{ax_1+bx_2+cx_3}{3}, \frac{ay_1+by_2+cy_3}{3}$ ☐
 (c) $\frac{ax_1+bx_2+cx_3}{a+b+c}, \frac{ay_1+by_2+cy_3}{a+b+c}$ ☐
 (d) None of the above ☐

64. In Q. 63 the coordinates of the centre of the escribed circle opposite to the angle A of the triangle ABC are given by

- (a) $\frac{-ax_1+bx_2+cx_3}{-a+b+c}, \frac{-ay_1+by_2+cy_3}{-a+b+c}$ ☐
 (b) $\frac{ax_1-bx_2-cx_3}{a-b-c}, \frac{ay_1-by_2-cy_3}{a-b-c}$ ☐
 (c) $\frac{ax_1-bx_2-cx_3}{-a+b+c}, \frac{ay_1-by_2-cy_3}{-a+b+c}$ ☐
 (d) None of the above ☐

65. The equation of the two straight lines joining the origin to the points of intersection of the straight line $lx+my+n=0$ and the curve $ax^2+2hxy+by^2+2gx+2fy+c=0$ is given by

- (a) $ax^2+2hxy+by^2+2(gx+fy)\left(\frac{lx+my}{n}\right)+c\left(\frac{lx+my}{n}\right)^2=0$ ☐
 (b) $ax^2+2hxy+by^2+2(gx+fy)(lx+my)+c(lx+my)^2=0$ ☐
 (c) $2(gx+fy)\left(\frac{lx+my}{n}\right)+c=0$ ☐
 (d) $2(gx+fy)+c\frac{(lx+my)^2}{n^2}=0$ ☐

66. The condition that one of the straight lines given by the equation $ax^2+2hxy+by^2$ may coincide with one of those given by the equation

$a'x^2+2h'xy+b'y^2=0$, is given by

- (a) $(ab'-a'b)^2=4(ha'-h'a)(bh'-b'h)$ ☐
 (b) $(ab'-a'b)^2=4(ha'-h'a)(hb'-h'b)$ ☐
 (c) $(ab'-a'b)^2=(ha'-h'a)(bh'-b'h)$ ☐
 (d) $(ab'-a'b)^2=2(ha'-h'a)(hb'-h'b)$ ☐

67. The two straight lines represented by the equation

$ax^3+bx^2y+cxy^2+dy^3=0$ are at right angles if

- (a) $a^2+bc+bd+cd=0$ ☐
 (b) $a^2+ad+bc+d^2=0$ ☐
 (c) $a^2+ac+bd+d^2=0$ ☐
 (d) $a^2+ab+cd+d^2=0$ ☐

68. If each of the pairs of straight lines $x^2-2pxy-y^2=0$ and $x^2-2qxy-y^2=0$ bisects the angles between the other pair, then

- (a) $pq=1$ ☐
 (b) $pq=-1$ ☐
 (c) $p^2=-q^2$ ☐
 (d) $p^2q^2=-1$ ☐

69. The equation of the circle whose centre is (h, k) and which passes through the origin, is given by

- (a) $x^2+y^2-2hx-2ky=0$ ☐
 (b) $x^2+y^2+2hx+2ky=0$ ☐
 (c) $x^2+y^2-2hx=0$ ☐
 (d) $x^2+y^2-2hx-2ky+h^2=0$ ☐

70. The equation of the circle whose centre lies on x -axis and radius is a , is given by

- (a) $x^2 + y^2 - 2hx + h^2 = a^2$ ☐
 (b) $x^2 + y^2 - 2hx - 2ky + h^2 = 0$ ☐
 (c) $x^2 + y^2 - 2hx - 2ky + k^2 = 0$ ☐
 (d) None of the above ☐

71. The equation of the circle, passing through the origin such that the x -axis is its diameter, is given by

- (a) $x^2 + y^2 - 2ky = 0$ ☐
 (b) $x^2 + y^2 - 2hx = 0$ ☐
 (c) $x^2 + y^2 - 2hx + h^2 = 0$ ☐
 (d) $x^2 + y^2 - 2ky + k^2 = 0$ ☐

72. $x^2 + y^2 - 2hx - 2ky + h^2 = 0$ is the equation of the circle whose centre is

- (a) $(-h, -k)$ and which touches the axis of y ☐
 (b) $(-h, -k)$ and which touches the axis of x ☐
 (c) (h, k) and which touches the axis of y ☐
 (d) (h, k) and which touches the axis of x ☐

73. The equation $x^2 + y^2 + 2gx + 2fy + c = 0$ represents a circle whose centre is

- (a) (g, f) and radius is $\sqrt{g^2 + f^2 - c}$ ☐
 (b) $(-g, -f)$ and radius is $(g^2 + f^2 - c)$ ☐
 (c) $(-2g, -2f)$ and radius is $\sqrt{g^2 + f^2 - c}$ ☐
 (d) $(-g, -f)$ and radius is $\sqrt{g^2 + f^2 - c}$ ☐

74. If in Q. 73, $g^2 + f^2 < c$, then the given equation represents a circle with

- (a) Real centre and real radius ☐
 (b) radius zero, called the point circle ☐
 (c) Real centre and imaginary radius ☐
 (d) Imaginary centre and imaginary radius ☐

75. The general equation of second degree $ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$ represents a circle if

- (a) $h = 0$ ☐
 (b) $a = b$ but $h \neq 0$, ☐
 (c) a may or may not be equal to b but $h = 0$ ☐
 (d) $a = b$ and $h = 0$ ☐

76. How many independent geometrical conditions are required for determining a circle?

- (a) Only two ☐
 (b) Only one ☐
 (c) Atleast three ☐
 (d) Exactly three ☐

77. The equation of the circle whose diameter is the line segment joining (x_1, y_1) and (x_2, y_2) , is given by

- (a) $(x - x_1)(y - y_1) + (x - x_2)(y - y_2) = 0$ ☐
 (b) $(x - x_1)(x - x_2) + (y - y_1)(y - y_2) = 0$ ☐
 (c) $(x - x_1)(y - y_2) + (x - x_2)(y - y_1) = 0$ ☐
 (d) $(x - x_1)(x - x_2) = (y - y_1)(y - y_2)$ ☐

78. The intercept made on the x -axis by the circle $ax^2 + ay^2 + 2gx + 2fy + c = 0$ is given by

- (a) $\frac{\sqrt{g^2 - ac}}{2a}$ ☐
 (b) $\frac{\sqrt{g^2 - 4ac}}{2a}$ ☐
 (c) $\frac{2\sqrt{g^2 - 4ac}}{a}$ ☐
 (d) $\frac{2\sqrt{g^2 - ac}}{a}$ ☐

79. The circle in Q. 78 will touch the axis of x if

- (a) $g^2 = ac$ ☐
 (b) $g^2 > ac$ ☐
 (c) $g^2 < ac$ ☐
 (d) $c < 0$ ☐

80. The circle in Q. 78 will never meet the x -axis if

- (a) $g^2 = ac$ ☐
 (b) $g^2 > ac$ ☐
 (c) $g^2 < ac$ ☐
 (d) $c < 0$ ☐

81. The circle in Q. 78 meets the axis of x in two points lying on opposite sides of the origin if

- (a) $c > 0$ ☐
 (b) $c < 0$ ☐
 (c) $c = 0$ ☐
 (d) $c \leq 0$ ☐

82. The equation of the tangent at any point (x', y') on the circle

$$x^2 + y^2 + 2gx + 2fy + c = 0, \text{ is given by}$$

- (a) $x^2 + y^2 + 2g(x+x') + 2f(y+y') + c = 0$ ☐
 (b) $xx' + yy' + 2g(x+x') + 2f(y+y') + c = 0$ ☐
 (c) $xx' + yy' + g(x+x') + f(y+y') + c = 0$ ☐
 (d) $g(x+x') + f(y+y') + c = 0$ ☐

83. The line $y = mx + c$ cuts the circle $x^2 + y^2 = a^2$, in two points only if

- (a) $c^2 < a^2(1+m^2)$ ☐
 (b) $c^2 > a^2(1+m^2)$ ☐
 (c) $c < a(1+m^2)$ ☐
 (d) $c > a(1+m^2)$ ☐

84. The length of the chord intercepted by the circle $x^2 + y^2 = a^2$ on the straight line $y = mx + c$ is given by

- (a) $\frac{\sqrt{a^2(1+m^2) - c^2}}{1+m^2}$ ☐
 (b) $\frac{2\sqrt{a^2(1+m^2) - c^2}}{1+m^2}$ ☐
 (c) $\frac{2\sqrt{c^2 - a^2(1+m^2)}}{1+m^2}$ ☐
 (d) $2\sqrt{\frac{a^2(1+m^2) - c^2}{1+m^2}}$ ☐

85. The line $y = mx + c$ is a tangent to the circle $x^2 + y^2 = a^2$ at the point on the circle whose coordinates are given by

- (a) $\frac{ma}{\sqrt{1+m^2}}$ and $\frac{a}{\sqrt{1+m^2}}$ ☐
 (b) $\frac{-ma}{\sqrt{1+m^2}}$ and $\frac{-a}{\sqrt{1+m^2}}$ ☐
 (c) $\frac{-ma}{\sqrt{1+m^2}}$ and $\frac{a}{\sqrt{1+m^2}}$ ☐
 (d) $\frac{ma}{\sqrt{1+m^2}}$ and $\frac{-a}{\sqrt{1+m^2}}$ ☐

86. The equation of one of the tangents to the circle $x^2 + y^2 - 6x + 4y = 12$ || to the given straight line $4x + 3y + 5 = 0$, is given by

- (a) $4x + 3y = 19$ ☐
 (b) $3x - 4y = 19$ ☐
 (c) $4x + 3y + 19 = 0$ ☐
 (d) $3x - 4y + 19 = 0$ ☐

87. The equation of the normal at any point (x', y') of the circle

$$x^2 + y^2 + 2gx + 2fy + c = 0$$

is given by

- (a) $xy' - yx' + f(x-x') + g(y-y') = 0$ ☐
 (b) $xy' - yx' + f(x'-x) + g(y-y') = 0$ ☐
 (c) $xy' - yx' + f(x'-x') + g(y'-y) = 0$ ☐
 (d) $xy' - yx' + f(x'-x) + g(y'-y) = 0$ ☐

88. From any given point how many tangents can be drawn to a circle?

- (a) Two ☐
 (b) Four ☐
 (c) Infinity ☐
 (d) None of the above ☐

89. $xx_1 + yy_1 = a^2$ is the equation of the

- (a) Tangent to the circle $x^2 + y^2 = a^2$ at the point (x_1, y_1) ☐
 (b) Chord of contact of tangents drawn from the external point (x_1, y_1) to the circle $x^2 + y^2 = a^2$ ☐
 (c) Polar of the point (x_1, y_1) w.r.t. the circle $x^2 + y^2 = a^2$ ☐
 (d) All of the above ☐

90. The pole of a given line $Ax + By + C = 0$ with respect to the circle $x^2 + y^2 = a^2$, is given by

- (a) $\left(\frac{A}{C}a^2, \frac{B}{C}a^2\right)$ ☐
 (b) $\left(-\frac{A}{C}a^2, -\frac{B}{C}a^2\right)$ ☐
 (c) $\left(\frac{A}{C}a^2, -\frac{B}{C}a^2\right)$ ☐
 (d) $\left(-\frac{A}{C}a^2, \frac{B}{C}a^2\right)$ ☐

91. The pole of the straight line $9x + y = 28$ with respect to the circle

$$2x^2 + 2y^2 - 3x + 5y - 7 = 0$$

is the point whose coordinates are

- (a) 3 and -1 ☐
 (b) -3 and -1 ☐
 (c) -3 and 1 ☐
 (d) 3 and 1 ☐

92. Which of the following statements is incorrect?

- (a) If the polar of a point P passes through a point Q , then polar of Q cannot pass through P . ☐
- (b) The intersection of the polars of two points P and Q is the pole of the line PQ . ☐
- (c) The square of the length of the tangent drawn from the point (x_1, y_1) to any circle is obtained by substituting x_1 for x and y_1 for y in the L.H.S. of the equation of the circle being written such that coefficients of x^2 and y^2 both are unity and the R.H.S. is zero. ☐
- (d) The equation of the pair of tangents that can be drawn from the point (x_1, y_1) to the circle $x^2 + y^2 = a^2$, is given by $(xx_1 + yy_1 - a^2)^2 + 2a^2(xx_1 + yy_1) = 0$. ☐
93. The coordinates of the point, from which the lengths of the tangents to the circles $x^2 + y^2 - 16x + 60 = 0$
 $3x^2 + 3y^2 - 36x + 81 = 0$
 $x^2 + y^2 - 16x - 12y + 84 = 0$ are equal, are given by
- (a) $\frac{87}{4}$ and 2 ☐
- (b) $\frac{33}{28}$ and 2 ☐
- (c) $\frac{33}{4}$ and 2 ☐
- (d) None of the above ☐
94. The length of the tangent drawn from the point $(6, -7)$ to the circle $3x^2 + 3y^2 - 7x - 6y - 12 = 0$ is given by
- (a) 73 ☐
- (b) 81 ☐
- (c) $\sqrt{73}$ ☐
- (d) None of the above ☐
95. If (R, α) is the centre of the circle in terms of polar coordinates and a be its radius, then the polar equation of such circle is given by
- (a) $r^2 + 2Rr \sin(\theta - \alpha) + R^2 - a^2 = 0$ ☐
- (b) $r^2 - 2Rr \sin(\theta - \alpha) - a^2 = 0$ ☐
- (c) $r^2 - 2Rr \cos(\theta - \alpha) + R^2 - a^2 = 0$ ☐
- (d) None of the above ☐
96. The polar equation of a circle with centre (R, α) , radius a and passing through the pole, is given by
- (a) $r^2 - 2Rr \cos \theta + R^2 - a^2 = 0$ ☐
- (b) $r = 2a \cos(\theta - \alpha)$ ☐
- (c) $r = 2a \cos \theta$ ☐
- (d) None of the above ☐
97. The co-ordinates of the centre of a circle $r = A \cos \theta + B \sin \theta$ are given by
- (a) $\sqrt{A^2 + B^2}$ and $\tan^{-1} B/A$ ☐
- (b) $\frac{1}{2}$ and $\tan^{-1} A/B$ ☐
- (c) $\frac{1}{2}\sqrt{A^2 + B^2}$ and $\tan^{-1} B/A$ ☐
- (d) None of the above ☐
98. The equation of the tangent to the circle $r = 2a \cos \theta$ at any point (r_1, θ_1) is given by
- (a) $r \cos(\theta - \theta_1) = 2a \cos^2 \theta_1$ ☐
- (b) $r \cos(\theta - 2\theta_1) = a \cos^2 \theta_1$ ☐
- (c) $r \cos(\theta - \theta_1) = \cos^2 \theta_1$ ☐
- (d) $r \cos(\theta - 2\theta_1) = 2a \cos^2 \theta_1$ ☐
99. The circles $x^2 + y^2 + 2gx + 2fy + c = 0$ and $x^2 + y^2 + 2g'x + 2f'y + c' = 0$ cut each other orthogonally if
- (a) $2(gg' + ff') = c + c'$ ☐
- (b) $gg' + ff' = 2(c + c')$ ☐
- (c) $2(gg' - ff') = c - c'$ ☐
- (d) $(gg' - ff') = 2(c - c')$ ☐
100. The radical axis of the two circles $x^2 + y^2 + 2gx + 2fy + c = 0$ and $x^2 + y^2 + 2g_1x + 2f_1y + c_1 = 0$ is given by
- (a) $x(g - g_1) + y(f - f_1) + (c - c_1) = 0$ ☐
- (b) $x(g - g_1) + y(f - f_1) + 2(c - c_1) = 0$ ☐
- (c) $x(g + g_1) + y(f + f_1) + (c + c_1) = 0$ ☐
- (d) $2x(g - g_1) + 2y(f - f_1) + (c - c_1) = 0$ ☐
101. The radical axis of two circles is a line
- (a) Parallel to the line joining their centres ☐
- (b) Which makes an angle of 45° with the line joining their centres ☐

- (c) Perpendicular to the line joining their centres ☐
 (d) None of the above ☐

102. Which one of following statements is incorrect ?

- (a) The radical axes of the three circles, taken in pairs, meet in a point ☐
 (b) The radical axis of two circles is the locus of a point which moves so that the lengths of the tangents drawn from it to the two circles are equal ☐
 (c) The radical centre is the point of intersection of the three radical axes, taken in pairs ☐
 (d) One of the above statements is incorrect ☐

103. A system of circles is said to be coaxial if

- (a) Any two of their radical axes are same ☐
 (b) They have a common radical axis ☐
 (c) Their radical centre is (0, 0) ☐
 (d) Their radical centre either lies on x-axis or on y-axis ☐

104. Centres of all the three circles of a coaxial system

- (a) Are the vertices of an equilateral triangle ☐
 (b) Are the vertices of an isosceles triangle ☐
 (c) Lie in a straight line ☐
 (d) Lie on their common radical axis ☐

105. One of two circles

$$x^2 + y^2 + ax + b = 0$$

and

$$x^2 + y^2 + a'x + b' = 0$$

will be within the other if

- (a) $aa' > 0$ but $b < 0$ ☐
 (b) $aa' < 0$ but $b > 0$ ☐
 (c) $aa' < 0$ and $b < 0$ ☐
 (d) $aa' > 0$ and $b > 0$ ☐

106. A system of coaxial circles has—limiting point(s)

- (a) Only one ☐
 (b) Two ☐
 (c) At the most two ☐
 (d) At least two ☐

107. The locus of a point which moves such that its distance from the fixed point is equal to its perpendicular distance from the fixed straight line is called a

- (a) Parabola ☐
 (b) Hyperbola ☐
 (c) Ellipse ☐
 (d) Circle ☐

108. Which of the following does not represent parabola ?

- (a) $y^2 = 4ax$ ☐
 (b) $x = \frac{a}{m^2}$, $y = \frac{2a}{m}$ ☐
 (c) $x = at^2$, $y = 2at$ ☐
 (d) $xy = c^2$ ☐

109. The length of the perpendicular from any point $P(x_1, y_1)$ on the parabola $y^2 = 4ax$ to the x-axis is equal to

- (a) $4ax_1$ ☐
 (b) $4a$ ☐
 (c) $2\sqrt{ax_1}$ ☐
 (d) None of the above ☐

110. The latus rectum of the parabola $y^2 = 4ax$ is equal to

- (a) a ☐
 (b) $2a$ ☐
 (c) $2\sqrt{a}$ ☐
 (d) $4a$ ☐

111. The eccentricity of the parabola $y^2 = 4ax$ is

- (a) Equal to one ☐
 (b) Greater than one ☐
 (c) Less than one ☐
 (d) Equal to $\sqrt{2}$ ☐

112. For what point of the parabola $y^2 = 18x$, the ordinate is equal to 3 times the abscissa ?

- (a) (1, 3) ☐
 (b) (2, 6) ☐
 (c) (8, 24) ☐
 (d) All of the above ☐

113. The equation of the tangent at any point (x_1, y_1) of the parabola $y^2 = 4ax$ is given by

(a) $yy_1 = 4a(x + x_1)$ ☐

(b) $yy_1 = \frac{a}{2}(x + x_1)$ ☐

(c) $yy_1 = 2a'(x + x_1)$ ☐

(d) $yy_1 = \frac{a}{4}(x + x_1)$ ☐

114. $y = mx + \frac{a}{m}$ is the equation of the tangent to the parabola $y^2 = 4ax$ at the point

(a) $\left(\frac{a}{m^2}, \frac{2a}{m}\right)$ ☐

(b) $\left(\frac{a}{m}, \frac{a(m+1)}{m}\right)$ ☐

(c) $(am^2, -2am)$ ☐

(d) None of the above ☐

115. The equation of the normal at any point $(am^2, -2am)$ of the parabola $y^2 = 4ax$, is given by

(a) $y = mx + 2am + am^3$ ☐

(b) $y = mx - 2am - am^3$ ☐

(c) $y = mx - 2am - am^3$ ☐

(d) $y = mx - 2am - am^4$ ☐

116. The straight line $y = mx + c$ is a tangent to the parabola $y^2 = 4a(x + a)$ if

(a) $c = am + \frac{a}{m^2}$ ☐

(b) $c = am^2 + \frac{a}{m}$ ☐

(c) $c = \frac{a}{m}$ ☐

(d) $c = ma + \frac{a}{m}$ ☐

117. The straight line $lx + my + n = 0$ is a tangent to the parabola $y^2 = 4ax$ if

(a) $ln = am^2$ ☐

(b) $mi = an^2$ ☐

(c) $nm = al^2$ ☐

(d) $ln = am$ ☐

118. If the tangent and normal at any point P of the parabola meet the axis in T and G respectively and S be the focus of the parabola, then

(a) $PT = PG = PS$ ☐

(b) $TG = 2SG = 2SP$ ☐

(c) $PG = PS = SG$ ☐

(d) None of the above ☐

119. Through any given point how many tangents to the parabola can pass?

(a) 2 ☐

(b) 4 ☐

(c) ∞ ☐

(d) None of the above ☐

120. The equation to the polar of the focus with respect to the parabola $y^2 = 4ax$ is

(a) $x = 0$ ☐

(b) $y = 0$ ☐

(c) $x = y$ ☐

(d) $x + a = 0$ ☐

121. The coordinates of the pole of the given straight line

$$Ax + By + C = 0$$

with respect to the parabola $y^2 = 4ax$ are given by

(a) $-\frac{C}{A}$ and $-\frac{B}{A}$ ☐

(b) $\frac{C}{A}$ and $-\frac{2Ba}{A}$ ☐

(c) $\frac{B}{A}$ and $-\frac{2Ca}{A}$ ☐

(d) $\frac{C}{A}$ and $-\frac{Ba}{A}$ ☐

122. Which of the following are not the parametric coordinates of any point on the parabola $y^2 = 4ax$

(a) $(at^2, 2at)$ ☐

(b) $(a, 2a)$ ☐

(c) $\left(\frac{a}{m^2}, \frac{2a}{m}\right)$ ☐

(d) $(am^2, -2am)$ ☐

123. The area of the triangle formed by three points on a parabola is how many times the area of triangle formed by the tangents at these points?

(a) Two ☐

(b) Three ☐

(c) Four ☐

(d) Five ☐

124. The circle circumscribing the triangle formed by any three tangents to a parabola passes through the

- (a) Origin ☐
 (b) Focus ☐
 (c) Vertex ☐
 (d) Focus as well as the vertex ☐

125. The orthocentre of any triangle formed by three tangents to a parabola lies on the

- (a) Parabola itself ☐
 (b) Latus rectum ☐
 (c) Directrix ☐
 (d) x-axis ☐

126. If the normal at the point $(at_1^2, 2at_1)$ meets the parabola again in $(at_2^2, 2at_2)$, then

- (a) $t_2 = t_1 + \frac{2}{t_1}$ ☐
 (b) $t_1 = t_2 + \frac{2}{t_2}$ ☐
 (c) $t_2 = -t_1 + \frac{1}{t_1}$ ☐
 (d) $t_2 = -t_1 - \frac{2}{t_1}$ ☐

127. The area of the triangle formed by the normals to the parabola $y^2 = 4ax$ at the points ' t_1 ', ' t_2 ' and ' t_3 ' is given by

- (a) $\frac{a^2}{2} (t_2 - t_3)(t_3 - t_1)(t_1 - t_2)$ ☐
 (b) $\frac{a}{2} (t_2 - t_3)(t_3 - t_1)(t_1 - t_2)(t_1 + t_2 + t_3)^2$ ☐
 (c) $\frac{a^2}{2} (t_2 - t_3)(t_3 - t_1)(t_1 - t_2)(t_1 + t_2 + t_3)^2$ ☐
 (d) None of the above ☐

128. How many normals can be drawn from any point to the given parabola?

- (a) Two ☐
 (b) Three ☐
 (c) Four ☐
 (d) Six ☐

129. The algebraic sum of the ordinates of the feet of the three normals drawn from any point to the given parabola

- (a) Is necessarily zero ☐
 (b) Is not necessarily zero ☐

- (c) Is any positive integer ☐
 (d) Is a fixed positive integer ☐

130. If the normals at three points of the parabola P , Q and R meet in a point O and S be the focus of the parabola, then $SP \cdot SQ \cdot SR =$

- (a) SO^2 ☐
 (b) $a^2 \cdot SO^2$ ☐
 (c) $\sqrt{a \cdot SO}$ ☐
 (d) $a \cdot SO^2$ ☐

131. The equation of the type

$$\sqrt{\frac{x}{a}} + \sqrt{\frac{y}{b}} = 1$$

represents a/an — such that any two tangents to it are the coordinate axes itself and a and b are the distances from the origin to the point of contact on x-axis and y-axis respectively

- (a) Parabola ☐
 (b) Ellipse ☐
 (c) Rectangular hyperbola ☐
 (d) Hyperbola ☐

132. The general equation of the parabola is of the type

- (a) $(Ax + By)^2 + 2gx + 2fy + C = 0$ ☐
 (b) $ax^2 + 2hxy + by^2 = 0$ ☐
 (c) $ax^2 + 2hxy + by^2 + 2gx + 2fy + C = 0$ ☐
 (d) All of the above ☐

133. The equation of the tangent at any point (x', y') of the parabola

$$\sqrt{\frac{x}{a}} + \sqrt{\frac{y}{b}} = 1$$

is given by

- (a) $\sqrt{\frac{x'}{a}} + \sqrt{\frac{y'}{b}} = 1$ ☐
 (b) $\frac{x}{\sqrt{ax'}} + \frac{y}{\sqrt{by'}} = 1$ ☐
 (c) $\sqrt{\frac{x}{ax'}} + \sqrt{\frac{y}{by'}} = 1$ ☐
 (d) $\sqrt{\frac{a}{x'}} + \sqrt{\frac{b}{y'}} = 1$ ☐

134. A conic with eccentricity less than 1 is a/an

- (a) Hyperbola ☐
 (b) Paraboloid of Revolution ☐

- (c) Circle ☐
 (d) Ellipse ☐

135. In general four normals can be drawn from a point to which of the following conics ?

- (a) Circle ☐
 (b) Ellipse ☐
 (c) Hyperbola ☐
 (d) Parabola ☐

136. Ellipse can be obtained by which of the following positions of a plane cutting a cone ?

- (a) Parallel to the base of a cone ☐
 (b) Parallel to the axis and not passing through the vertex of the cone ☐
 (c) Neither parallel to the axis of the cone, nor passing through its vertex but cutting its base ☐
 (d) Not parallel to the base of the cone but cuts the cone without cutting the base ☐

137. The equation

$$x^2 - 2xy + y^2 + 3x + 2 = 0$$

represents a/an

- (a) Parabola ☐
 (b) Ellipse ☐
 (c) Hyperbola ☐
 (d) Circle ☐

138. The equation

$$x^2 + 4xy + y^2 + 2x + 4y + 2 = 0$$

represents a/an

- (a) Ellipse ☐
 (b) Pair of straight lines ☐
 (c) Hyperbola ☐
 (d) None of the above ☐

139. The equation

$$x^2 + xy + y^2 + 2x + 3 = 0$$

represents a/an

- (a) Parabola ☐
 (b) Hyperbola ☐
 (c) Pair of straight lines ☐
 (d) Ellipse ☐

140. Locus of all points on the conic such that the sum of its distance from the two foci is constant is a/an

- (a) Circle ☐
 (b) Parabola ☐
 (c) Ellipse ☐
 (d) Hyperbola ☐

141. An ellipse has/can have

- (a) Two foci and one directrix only ☐
 (b) Two foci and two directrices ☐
 (c) Two foci and any number of directrices ☐
 (d) Any number of foci and directrices ☐

142. The coordinates of the foci of an ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ are given by

- (a) $(a/e, 0)$ and $(-a/e, 0)$ ☐
 (b) $(ae, 0)$ and $(-a/e, 0)$ ☐
 (c) $(-ae, 0)$ and $(a/e, 0)$ ☐
 (d) $(ae, 0)$ and $(-ae, 0)$ ☐

143. The directrices of an ellipse

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

are given by

- (a) $x = a/e$ and $y = b/e$ ☐
 (b) $x = a/e$ and $x = e/a$ ☐
 (c) $x = a/e$ and $x = -a/e$ ☐
 (d) $x = ae$ and $x = -ae$ ☐

144. The eccentricity of the ellipse

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

is given by

- (a) $e^2 = \frac{b^2 - a^2}{a^2}$ ☐
 (b) $e^2 = \frac{b^2 - a^2}{b^2}$ ☐
 (c) $e^2 = \frac{a^2 - b^2}{b^2}$ ☐
 (d) $e^2 = \frac{a^2 - b^2}{a^2}$ ☐

145. The latus rectum of the ellipse

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

is equal to

- (a) b^2/a
 (b) $2b^2/a$
 (c) b/a
 (d) $2a^2/b$

146. The sum of the focal radii of any point on the ellipse is equal to the

- (a) Length of the latus rectum
 (b) Length of the major axis
 (c) Length of the minor axis
 (d) Eccentricity

147. The length of the semi-minor axis is given by

- (a) $b^2 = a^2 e^2$
 (b) $b^2 = a^2 (e^2 - 1)$
 (c) $b^2 = 2a(1 - e^2)$
 (d) $b^2 = a^2(1 - e^2)$

148. The equation

$$\frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1$$

represents a/an

- (a) Circle with centre (h, k) and radius $\sqrt{ab}$
 (b) Circle with centre (h, k) and radius either a or b
 (c) Ellipse with centre (h, k) and major axis and minor axis as $x-h=0, y-k=0$ respectively
 (d) Ellipse with centre (h, k) and major and minor axis as $y-k=0$ and $x-h=0$ respectively.

149. If the line $lx + my + n = 0$ represents the directrix, (α, β) be the coordinates of the focus corresponding to it and e be the eccentricity of the ellipse, then the equation of the ellipse is given by

- (a) $(x-\alpha)^2 + (y-\beta)^2 = e \frac{lx + my + n}{\sqrt{l^2 + m^2}}$
 (b) $\sqrt{(x-\alpha)^2 + (y-\beta)^2} = e \frac{lx + my + n}{\sqrt{l^2 + m^2}}$
 (c) $(x-\alpha)^2 + (y-\beta)^2 = e^2 \frac{(lx + my + n)^2}{l^2 + m^2}$
 (d) None of the above

150. The parametric coordinates of any point on the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ are given by

- (a) $x = a \cos \phi, y = b \sin \phi$
 (b) $x = a \sin \phi, y = b \cos \phi$
 (c) $x = a \coth \phi, y = b \operatorname{cosech} \phi$
 (d) $x = a \operatorname{sech} \phi, y = b \tanh \phi$

151. An angle ϕ is called the eccentric angle of the point P if the ordinate PM of the point P meets the circle described on the—as the diameter in the point Q

- (a) Major axis
 (b) Minor axis
 (c) Semi-major axis
 (d) Semi-minor axis

152. The equation of the chord joining any two points on the ellipse is given by

- (a) $ax \cos(\phi_1 + \phi_2) + by \sin(\phi_1 + \phi_2) = \cos(\phi_1 - \phi_2)$
 (b) $\frac{x}{a} \cos(\phi_1 + \phi_2) + \frac{y}{b} \sin(\phi_1 + \phi_2) = \cos(\phi_1 - \phi_2)$
 (c) $\frac{x}{a} \cos \frac{1}{2}(\phi_1 + \phi_2) + \frac{y}{b} \sin \frac{1}{2}(\phi_1 + \phi_2) = \cos \frac{1}{2}(\phi_1 - \phi_2)$
 (d) $ax \cos \frac{1}{2}(\phi_1 + \phi_2) + by \sin \frac{1}{2}(\phi_1 + \phi_2) = \cos \frac{1}{2}(\phi_1 - \phi_2)$

153. The equation $y = mx + c$ is a tangent to the ellipse if the value of c is given by

- (a) $\pm \sqrt{a^2 m^2 + b^2}$
 (b) $\pm \sqrt{a^2 m^2 - b^2}$
 (c) $\pm \sqrt{a^2 + m^2 b^2}$
 (d) $\pm \sqrt{a^2 - m^2 b^2}$

154. The equation of the normal at any point of the ellipse is given by

- (a) $ax \cos \phi + by \sin \phi = a^2 - b^2$
 (b) $ax \sec \phi - by \operatorname{cosec} \phi = a^2 - b^2$
 (c) $\frac{x}{a \cos \phi} - \frac{y}{b \sin \phi} = a^2 - b^2$
 (d) None of the above

155. The sum of the eccentric angles of the feet of the normals drawn from any point to an ellipse is

- (a) $2n\pi$ ☐
 (b) $(2n+1)\pi/2$ ☐
 (c) $n\pi$ ☐
 (d) $(2n+1)\pi$ ☐

156. If the latus rectum of an ellipse is equal to half its minor axis, then its eccentricity is equal to

- (a) 1 ☐
 (b) $\sqrt{3}$ ☐
 (c) $\frac{\sqrt{3}}{2}$ ☐
 (d) None of the above ☐

157. Which of the following points lies without the ellipse?

- (a) (1, 0) ☐
 (b) (0, 1) ☐
 (c) (-1, 0) ☐
 (d) (1, 1) ☐

158. The equation of the ellipse whose L.R. is 5 and $e=2/3$, is given by

- (a) $5x^2+9y^2=405$ ☐
 (b) $20x^2+36y^2=405$ ☐
 (c) $25x^2+45y^2=81$ ☐
 (d) None of the above ☐

159. A circle is said to be an auxiliary circle if

- (a) Its radius is unity ☐
 (b) It is described on the major axis of the ellipse as diameter ☐
 (c) It is described on the minor axis of the ellipse as diameter ☐
 (d) It is described on the line segment joining the foci of the ellipse as diameter ☐

160. The condition that the line $x \cos \alpha + y \sin \alpha = p$ touches the ellipse

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

is given by

- (a) $p^2 = a^2 \sin^2 \alpha + b^2 \cos^2 \alpha$ ☐
 (b) $p^2 = a^2 \cos^2 \alpha + b^2 \sin^2 \alpha$ ☐

(c) $p^2 = a^2 \cos^2 \alpha - b^2 \sin^2 \alpha$ ☐

(d) $p^2 = a^2 \sin^2 \alpha - b^2 \cos^2 \alpha$ ☐

161. The condition that the line $lx+my=n$ touches the ellipse

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1, \text{ is given by}$$

- (a) $a^2 l^2 + b^2 m^2 = n^2$ ☐
 (b) $al+bm=n$ ☐
 (c) $a^2 l^2 + b^2 m^2 = n$ ☐
 (d) $al+bm=n^2$ ☐

162. The locus of the point of intersection of tangents to the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ which meet at right angles is the *Director Circle*.

The radius of this circle is the

- (a) Join of the end points of the minor axis ☐
 (b) Join of the origin and the end point of the minor axis ☐
 (c) Join of the origin and the end point of the major axis ☐
 (d) Join of the end points of the major and minor axis ☐

163. The locus of the middle points of the parallel chords of the type $y=mx+c$ of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ is given by $y=m_1x$ where m_1 is equal to

- (a) $-\frac{b^2}{a^2m}$ ☐
 (b) $\frac{b^2}{a^2m^2}$ ☐
 (c) $\frac{b^2m}{a^2}$ ☐
 (d) $-\frac{b^2m^2}{a^2}$ ☐

164. The locus of the middle points of the parallel chords of an ellipse is known as the

- (a) Diameter not passing through the centre of the ellipse ☐
 (b) Director circle ☐
 (c) Auxiliary circle ☐
 (d) Diameter passing through the centre of the ellipse ☐

165. Two diameters are said to be conjugate if

- (a) They coincide ☐
 (b) They are perpendicular to each other ☐
 (c) Each of them bisects all chords parallel to the other ☐
 (d) Each of them bisects all chords perpendicular to the other ☐

166. If the eccentric angles of the ends P and D of a pair of conjugate diameters be ϕ and ϕ' , then ϕ and ϕ' can differ by

- (a) An acute angle only ☐
 (b) An obtuse angle only ☐
 (c) An acute angle not less than 45° ☐
 (d) A right angle ☐

167. Consider a pair of conjugate diameters of an ellipse. Then the area of the parallelogram formed by the tangents at the end of these diameters is equal to

- (a) $a.b$ ☐
 (b) $2a.b$ ☐
 (c) $4a.b$ ☐
 (d) None of the above ☐

168. The sum of the squares of semi-conjugate diameters of an ellipse is equal to the

- (a) Sum of squares of the axes of the ellipse ☐
 (b) Square of the semi-major axis of the ellipse ☐
 (c) Square of the semi-minor axis of the ellipse ☐
 (d) Sum of the squares of the semi-major and semi-minor axes of the ellipse ☐

169. The tangents at the extremities of a diameter of an ellipse

- (a) Coincide with the conjugate diameter ☐
 (b) Are parallel to the conjugate diameter ☐
 (c) Are perpendicular to the conjugate diameter ☐
 (d) Are inclined at an angle of 45° to the conjugate diameter ☐

170. Which is the correct statement? The product of the focal distances of a point P is equal to the square on the semi-diameter

- (a) Parallel to the tangent at P ☐
 (b) Perpendicular to the tangent at P ☐
 (c) Both of the above ☐
 (d) None of the above ☐

171. Two conjugate diameters are said to be equi-conjugate if they have the same length. What is the length of each of the equi-conjugate diameters of the ellipse

$$\frac{x^2}{1} + \frac{y^2}{49} = 1$$

- (a) 5 ☐
 (b) $\sqrt{\frac{5}{2}}$ ☐
 (c) $5\sqrt{2}$ ☐
 (d) 10 ☐

172. If the normal at an end of a L.R. of an ellipse

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

passes through one extremity of the minor axis, then eccentricity of the ellipse is given by

- (a) $e^4 + e^2 + 1 = 0$ ☐
 (b) $e^4 + e^3 + e^2 + e + 1 = 0$ ☐
 (c) $e^4 + e^2 - 1 = 0$ ☐
 (d) None of the above ☐

173. The eccentricity e of the hyperbola

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$$
 is given by

- (a) $b^2 = a^2(1 - e^2)$ ☐
 (b) $b^2 = a^2(e^2 - 1)$ ☐
 (c) $a^2 = b^2(1 - e^2)$ ☐
 (d) $a^2 = b^2(e^2 - 1)$ ☐

174. $2\frac{b^2}{a}$ is the L.R. of

- (a) The Parabola ☐
 (b) The Ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ ☐
 (c) The Hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ ☐
 (d) Both the ellipse & the hyperbola, whose equations are same as in (b) and (c) above ☐

175. The two axes of the hyperbola are called

- (a) Major axis and the minor axis ☐
 (b) Major axis and the conjugate axis ☐
 (c) Transverse axis and the minor axis ☐
 (d) Transverse axis and the conjugate axis ☐

176. For which of the following curves there exists a second focus and the second directrix ?

- (a) Ellipse & Hyperbola both ☐
 (b) Ellipse & Parabola both ☐
 (c) Parabola & Hyperbola both ☐
 (d) Ellipse only ☐

177. The eccentricity of the hyperbola can never be equal to

- (a) $\sqrt{\frac{9}{5}}$ ☐
 (b) $2\sqrt{\frac{1}{9}}$ ☐
 (c) $3\sqrt{\frac{1}{8}}$ ☐
 (d) Greater than 10 ☐

178. The difference of the focal distances of any point on the hyperbola is equal to its

- (a) Latus Rectum ☐
 (b) Eccentricity ☐
 (c) Transverse axis ☐
 (d) Semi-transverse axis ☐

179. No part of the hyperbola

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$$

lies between which of the following ?

- (a) $x = -2a$ and $x = 2a$ ☐
 (b) $x = -a$ and $x = a$ ☐
 (c) $y = -2b$ and $y = 2b$ ☐
 (d) $y = -b$ and $y = b$ ☐

180. Which of the following divides the hyperbola into two similar and equal parts ?

- (a) Axis of x only ☐
 (b) Axis of y only ☐
 (c) The line $x=a$ and $y=b$ ☐
 (d) Both the x -axis and y -axis ☐

181. The polar form of the equation of hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$, is given by

(a) $\frac{1}{r^2} = \frac{1}{a^2} - \left(\frac{1}{a^2} + \frac{1}{b^2} \right) \sin^2 \theta$ ☐

(b) $\frac{1}{r^2} = \frac{\cos^2 \theta}{a^2} - \frac{\sin^2 \theta}{b^2}$ ☐

(c) $\frac{1}{r^2} = \frac{\cos 2\theta}{a^2 b^2}$ ☐

(d) Two of the above only ☐

182. The line $y = mx + c$ is the tangent to the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ at any point on it if c is equal to

(a) $\sqrt{a^2 m^2 + b^2}$ ☐

(b) $\sqrt{a^2 m^2 - b^2}$ ☐

(c) $\sqrt{a^2 + b^2 m^2}$ ☐

(d) $\sqrt{a^2 - b^2 m^2}$ ☐

183. The straight line $lx + my + n = 0$ is a tangent to the hyperbola

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1 \text{ if}$$

(a) $a^2 l^2 - b^2 m^2 = n^2$ ☐

(b) $a^2 m^2 - b^2 n^2 = l^2$ ☐

(c) $a^2 n^2 - b^2 l^2 = m^2$ ☐

(d) $a^2 l^2 + b^2 m^2 = n^2$ ☐

184. The equation to the director circle of the hyperbola is given by

(a) $x^2 + y^2 = a^2 + b^2$ ☐

(b) $x^2 + y^2 = \sqrt{a^2 + b^2}$ ☐

(c) $x^2 + y^2 = a^2 b^2$ ☐

(d) $x^2 + y^2 = a^2 - b^2$ ☐

185. The line $x \cos \alpha + y \sin \alpha = p$ touches the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ if

(a) $p^2 = a^2 \cos^2 \alpha + b^2 \sin^2 \alpha$ ☐

(b) $p^2 = \sqrt{a^2 \cos^2 \alpha + b^2 \sin^2 \alpha}$ ☐

(c) $p^2 = a^2 \cos^2 \alpha - b^2 \sin^2 \alpha$ ☐

(d) $p^2 = a^2 \sin^2 \alpha - b^2 \cos^2 \alpha$ ☐

186. The locus of the middle points of all chords of the hyperbola which are parallel to $y = mx$ is the straight line $y = m'x$ such that

(a) $m + m' = \frac{2b^2}{a}$ ☐

(b) $mm' = \frac{b^2}{a^2}$ ☐

(c) $\frac{m}{m'} = \frac{b^2}{a^2}$ ☐

(d) $m - m' = \frac{2a^2}{b}$ ☐

187. Two conjugate diameters of the hyperbola are such that

- (a) Both meet the curve in real points ☐
- (b) Both meet the curve in imaginary points ☐
- (c) One meets the curve in real points and the other in imaginary points ☐
- (d) They are always coincident ☐

188. In the case of hyperbola, the difference of squares of two conjugate diameters is equal to the difference of the squares of the

- (a) Transverse and the conjugate axis ☐
- (b) Transverse and the semi-conjugate axis ☐
- (c) Semi-transverse and the conjugate axis ☐
- (d) Semi-transverse and the semi-conjugate axis ☐

189. The asymptote of hyperbola is a straight line meeting the curve at infinity in

- (a) Only one point ☐
- (b) Two points ☐
- (c) Three points ☐
- (d) Infinite number of points ☐

190. Which one of the following statements is incorrect?

- (a) The hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ has two real asymptotes ☐
- (b) The ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ has two asymptotes one real and the other imaginary ☐
- (c) Each asymptote of the hyperbola lies along a pair of coincident conjugate diameters ☐
- (d) Any straight line parallel to an asymptote will meet the curve in one point at infinity ☐

191. The asymptotes of the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ are given by

- (a) $b^2x^2 - a^2y^2 = 0$ ☐
- (b) $b^2x^2 + a^2y^2 = 0$ ☐
- (c) $a^2x^2 - b^2y^2 = 1$ ☐
- (d) $a^2x^2 + b^2y^2 = 1$ ☐

192. The angle between the asymptotes of the hyperbola is equal to

- (a) $\tan^{-1} b/a$ ☐
- (b) $\tan^{-1} a/b$ ☐
- (c) $2 \tan^{-1} a/b$ ☐
- (d) $2 \tan^{-1} b/a$ ☐

193. The equation of the tangent at any point of the rectangular hyperbola $xy = c^2$ is given by

- (a) $xy_1 + yx_1 = c^2$ ☐
- (b) $xy_1 - yx_1 = c^2$ ☐
- (c) $xx_1 + yy_1 = c^2$ ☐
- (d) $xx_1 - yy_1 = c^2$ ☐

194. Which one of the following is not an equation of rectangular hyperbola?

- (a) $x^2 - y^2 = a^2$ ☐
- (b) $xy = c^2$ ☐
- (c) $x = ct, y = c/t$ ☐
- (d) $\frac{y^2}{b^2} - \frac{x^2}{a^2} = 0$ ☐

195. The coordinates of the foci of the rectangular hyperbola $xy = c^2$ are

- (a) $(\pm a, 0)$ ☐
- (b) $(\pm a\sqrt{2}, 0)$ ☐
- (c) $(0, \pm a\sqrt{2})$ ☐
- (d) $(0, \pm ae)$ ☐

196. The equations of the directrices of the rectangular hyperbola $xy = c^2$ are

- (a) $x + y = \pm c\sqrt{2}$ ☐
- (b) $x \pm y = c\sqrt{2}$ ☐
- (c) $\sqrt{2}x + y = \pm c^2$ ☐
- (d) $x \pm \sqrt{2}y = c^2$ ☐

197. If a circle cuts the rectangular hyperbola $xy = 1$ in four points $(x_1, y_1), (x_2, y_2), (x_3, y_3)$ and (x_4, y_4) , then

- (a) $x_1 + x_2 + x_3 + x_4 = y_1 + y_2 + y_3 + y_4 = 0$ ☐
- (b) $x_1x_2x_3x_4 = y_1y_2y_3y_4 = -1$ ☐
- (c) $x_1x_2x_3x_4 = y_1y_2y_3y_4 = 1$ ☐
- (d) $x_1x_2 + x_3x_4 = y_1y_2 + y_3y_4 = 0$ ☐

198. If e and e' be the eccentricities of two conjugate hyperbolas, then

(a) $e^2 + e'^2 = 1$ ☐

(b) $e^2 + e'^2 = 4$ ☐

(c) $\frac{1}{e^2} + \frac{1}{e'^2} = 1$ ☐

(d) $\frac{1}{e^2} + \frac{1}{e'^2} = \frac{1}{4}$ ☐

199. In how many points a rectangular hyperbola is cut by any circle?

(a) Two ☐

(b) Four ☐

(c) Six ☐

(d) None of the above ☐

200. The equation of the rectangular hyperbola is $xy = c^2$ where $4c^2$ is equal to

(a) Sum of the squares of the semi-axes of the hyperbola ☐

(b) Sum of the squares of the semi-axes of the hyperbola ☐

(c) Square root of the sum of the squares of the semi-axes of the hyperbola ☐

(d) Differences of the squares of the semi-axes of the hyperbola ☐

201. The polar equation of a conic whose focus is the pole, e the eccentricity and $2l$ the latus rectum, is given by

(a) $\frac{l}{r} = 1 + e \cos \theta$ ☐

(b) $\frac{l}{r} = 1 - e \cos \theta$ ☐

(c) $r = l(1 + e \cos \theta)$ ☐

(d) $r = el \cos \theta$ ☐

202. The polar equation of a conic whose axis is inclined at an angle α to the initial line is given by

(a) $\frac{l}{r} = 1 + e \cos (\theta + \alpha)$ ☐

(b) $\frac{l}{r} = 1 - e \cos (\theta + \alpha)$ ☐

(c) $\frac{l}{r} = 1 + e \cos (\theta - \alpha)$ ☐

(d) $\frac{l}{r} = 1 - e \cos \left(\frac{n\pi}{2} + \theta - \alpha \right)$ ☐

203. The equation of the directrix of the conic $\frac{l}{r} = 1 + e \cos \theta$ corresponding to its focus is given by

(a) $\frac{l}{r} = e \sin \theta$ ☐

(b) $\frac{l}{r} = \frac{1}{e} \sin \theta$ ☐

(c) $\frac{l}{r} = e \cos \theta$ ☐

(d) $r = el \cos \theta$ ☐

204. In any conic, the semi-latus rectum is a—between the segments of any focal chord

(a) Arithmetic mean ☐

(b) Geometric mean ☐

(c) Harmonic mean ☐

(d) None of the above ☐

205. The equation of the directrix of the conic $\frac{l}{r} = 1 + e \cos \theta$ other than that corresponding to its focus is given by

(a) $\frac{l}{r} = \frac{1 - e^2}{1 + e^2} \cos \theta$ ☐

(b) $\frac{l}{r} = \frac{1 + e^2}{1 - e^2} \cos \theta$ ☐

(c) $\frac{l}{r} = e \frac{1 - e^2}{1 + e^2} \cos \theta$ ☐

(d) $\frac{l}{r} = e \cos \theta$ ☐

206. The equation of the chord of the conic $\frac{l}{r} = 1 + e \cos \theta$ joining the points $\alpha - \beta$, $\alpha + \beta$ is given by

(a) $\frac{l}{r} = 1 + \cos (\theta - \alpha) \cos (\theta - \beta)$ ☐

(b) $\frac{l}{r} = \sec \beta \cos (\theta - \alpha) + e \cos \theta$ ☐

(c) $\frac{l}{r} = \cos \beta \cos (\theta - \alpha) + e \cos \theta$ ☐

(d) $\frac{l}{r} = \cos (\theta - \alpha) + e \cos (\theta - \beta)$ ☐

207. The chord PQ joining the points $\alpha - \beta$, $\alpha + \beta$ subtends an angle—at the focus of the conic $\frac{l}{r} = 1 + e \cos \theta$

- (a) 2β
 (b) 2α
 (c) $\alpha + \beta$
 (d) $\alpha - \beta$

208. The bisector of the angle subtended by the chord joining the points $\alpha - \beta$ and $\alpha + \beta$ at the focus makes an angle— with the initial line

- (a) 2α
 (b) 2β
 (c) α
 (d) β

209. The equation of the chord of the conic $\frac{l}{r} = 1 + e \cos \theta$ passing through the focus and inclined at an angle α with the initial line is given by

- (a) $r = \alpha$
 (b) $\theta = \alpha$
 (c) $\theta = \pi/2$
 (d) $\theta = \alpha - \pi/2$

210. The equation of the tangent at any point α on the conic $\frac{l}{r} = 1 + e \cos \theta$, is given by

- (a) $\frac{l}{r} = \cos \alpha + e \cos \theta$
 (b) $\frac{l}{r} = e \cos (\theta - \alpha) + \cos \theta$
 (c) $\frac{l}{r} = \cos (\theta - \alpha) + e \cos \theta$
 (d) $\frac{l}{r} = 1 + e \cos \alpha$

211. The asymptotes of the conic

$$\frac{l}{r} = 1 + e \cos \theta$$

are given by

$$\frac{l}{r} = \sqrt{\frac{e^2 - 1}{e}} (\sqrt{e^2 - 1} \cos \theta \pm \sin \theta) \text{ if}$$

- (a) $e \geq 1$
 (b) $e \leq 1$
 (c) $e > 1$ or $e < 1$
 (d) $e > 1$

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212. The equation of the polar of a point (r_1, θ_1) w.r.t. the conic $\frac{l}{r} = 1 + e \cos \theta$ is given by

- (a) $\left(\frac{l}{r_1} - 1 - e \cos \theta \right) \left(\frac{l}{r} - 1 - e \cos \theta_1 \right) = \cos (\theta - \theta_1)$
 (b) $\left(\frac{l}{r} - e \cos \theta \right) \left(\frac{l}{r} - e \cos \theta_1 \right) = 0$
 (c) $\left(\frac{l}{r} - e \cos \theta \right) \left(\frac{l}{r_1} - e \cos \theta_1 \right) = \cos (\theta - \theta_1)$
 (d) $\left(\frac{l}{r} - e \cos \theta \right) \left(\frac{l}{r} - e \cos \theta_1 \right) = \sin (\theta - \theta_1)$

213. Which of the following equations represent the same conic?

- (1) $\frac{l}{r} = 1 + e \cos \theta$
 (2) $\frac{l}{r} = -1 + e \cos \theta$
 (3) $\frac{l}{r} = -1 - e \cos \theta$
 (4) $\frac{l}{r} = 1 - e \cos \theta$

- (a) (1), (2) and (3)
 (b) (1) and (4)
 (c) (2) and (3)
 (d) (1), (2), (3) and (4)

214. The condition that the line

$$\frac{l}{r} = A \cos \theta + B \sin \theta$$

may be a tangent to the conic

$$\frac{l}{r} = 1 + e \cos \theta,$$

is given by

- (a) $(A - e)^2 + (B - e)^2 = 1$
 (b) $(A - e)^2 + B^2 = 0$
 (c) $A^2 + (B - e)^2 = 0$
 (d) $(A - e)^2 + B^2 = 1$

215. Which of the following statements is incorrect regarding the conic

$$\frac{l}{r} = 1 + e \cos \theta?$$

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- (a) The tangents at the ends of any focal chord meet on the directrix ☐
 (b) The sum of the reciprocals of two perpendicular focal chords is constant ☐
 (c) The portion of the tangents intercepted between the curve and the directrix subtends a right angle to the corresponding focus ☐
 (d) At least one of the above statements is incorrect ☐

216. If the normals at the points α, β, γ on the conic $\frac{l}{r} = 1 + e \cos \theta$ meet in a point whose vectorial angle is ψ , then

- (a) $2\psi = \alpha + \beta + \gamma$
 (b) $\psi = \alpha + \beta + \gamma$
 (c) $\psi = 2(\alpha + \beta + \gamma)$
 (d) $\psi = 4(\alpha + \beta + \gamma)$

217. The director circle of the conic

$$\frac{l}{r} = 1 + e \cos \theta$$

is given by

- (a) $r^2 e^2 + 2lre \cos \theta - 2l^2 = 0$
 (b) $r^2(1 - e^2) + 2lr(1 - e) \cos \theta - 2l^2 = 0$
 (c) $r^2(1 - e^2) + 2lre \cos \theta - 2l^2 = 0$
 (d) $r^2(1 - e^2) + 2lr \cos \theta - 2l^2 = 0$

ANSWERS

- | | | | | | |
|--------|--------|--------|--------|--------|--------|
| 1. c | 2. d | 3. a | 112. b | 113. c | 114. a |
| 4. c | 5. d | 6. d | 115. c | 116. d | 117. a |
| 7. c | 8. b | 9. a | 118. b | 119. a | 120. d |
| 10. b | 11. b | 12. a | 121. b | 122. b | 123. a |
| 13. c | 14. d | 15. b | 124. b | 125. c | 126. d |
| 16. b | 17. c | 18. b | 127. c | 128. b | 129. a |
| 19. a | 20. c | 21. b | 130. d | 131. a | 132. a |
| 22. a | 23. a | 24. a | 133. b | 134. d | 135. b |
| 25. c | 26. a | 27. a | 136. d | 137. a | 138. c |
| 28. c | 29. a | 30. d | 139. d | 140. c | 141. b |
| 31. b | 32. b | 33. b | 142. d | 143. c | 144. d |
| 34. a | 35. a | 36. d | 145. b | 146. b | 147. d |
| 37. d | 38. c | 39. c | 148. d | 149. b | 150. a |
| 40. d | 41. a | 42. b | 151. a | 152. c | 153. a |
| 43. b | 44. b | 45. a | 154. b | 155. d | 156. c |
| 46. c | 47. d | 48. b | 157. d | 158. b | 159. b |
| 49. a | 50. b | 51. a | 160. b | 161. a | 162. d |
| 52. b | 53. c | 54. c | 163. a | 164. d | 165. c |
| 55. b | 56. c | 57. c | 166. d | 167. c | 168. d |
| 58. a | 59. c | 60. d | 169. b | 170. a | 171. a |
| 61. b | 62. a | 63. c | 172. c | 173. b | 174. d |
| 64. a | 65. a | 66. a | 175. d | 176. a | 177. b |
| 67. c | 68. b | 69. a | 178. c | 179. b | 180. d |
| 70. a | 71. b | 72. d | 181. d | 182. b | 183. a |
| 73. d | 74. c | 75. d | 184. d | 185. c | 186. b |
| 76. d | 77. b | 78. d | 187. c | 188. d | 189. b |
| 79. a | 80. c | 81. b | 190. b | 191. a | 192. d |
| 82. c | 83. a | 84. d | 193. a | 194. d | 195. b |
| 85. c | 86. c | 87. c | 196. a | 197. c | 198. c |
| 88. a | 89. d | 90. b | 199. b | 200. a | 201. a |
| 91. a | 92. a | 93. c | 202. c | 203. c | 204. c |
| 94. d | 95. c | 96. b | 205. c | 206. b | 207. a |
| 97. c | 98. d | 99. a | 208. c | 209. b | 210. c |
| 100. d | 101. c | 102. d | 211. d | 212. c | 213. a |
| 103. b | 104. c | 105. d | 214. d | 215. d | 216. a |
| 106. b | 107. a | 108. d | 217. c | | |
| 109. c | 110. d | 111. a | | | |

Section --B

THREE DIMENSIONAL GEOMETRY

1. The three coordinate planes divide the whole space into how many octants ?
 - (a) 3 ☐
 - (b) 6 ☐
 - (c) 8 ☐
 - (d) 12 ☐
2. The perpendicular distance of any point $P(x, y, z)$ from the z -axis is given by
 - (a) $\frac{z}{\sqrt{x^2+y^2+z^2}}$ ☐
 - (b) $\sqrt{x^2+y^2}$ ☐
 - (c) 1 ☐
 - (d) z ☐
3. What is the locus of a point for which $y=b$?
 - (a) A plane parallel to ZX plane at a distance b from it. ☐
 - (b) A plane parallel to XY plane at a distance b from it. ☐
 - (c) A plane parallel to YZ plane at a distance b from it. ☐
 - (d) A line parallel to X axis at a distance b from it. ☐
4. What is the locus of a point for which $x=a$ and $y=b$?
 - (a) A line parallel to XY plane ☐
 - (b) A plane parallel to XY plane ☐
 - (c) A line parallel to Z -axis ☐
 - (d) A plane perpendicular to XY plane ☐
5. What are the lengths of the edges of the rectangular parallelepiped formed by planes drawn through the points (a, b, c) and (p, q, r) parallel to the coordinate planes ?
 - (a) $\frac{a+p}{2}, \frac{b+q}{2}, \frac{c+r}{2}$ ☐
 - (b) $p-a, q-b, r-c$ ☐
 - (c) $a+p, b+q, c+r$ ☐
 - (d) $\frac{p-a}{2}, \frac{q-b}{2}, \frac{r-c}{2}$ ☐
6. Which of the following figures is formed by the points whose coordinates are $(0, 7, 10), (-1, 6, 6), (-4, 9, 6)$?
 - (a) A right angled triangle ☐
 - (b) An equilateral triangle ☐
 - (c) An isosceles triangle ☐
 - (d) An isosceles and right angled triangle ☐
7. The point $(4, 3, -6)$ lies in which of the eight octants ?
 - (a) $OX'Y'Z'$ ☐
 - (b) $OXYZ'$ ☐
 - (c) $OX'Y'Z$ ☐
 - (d) $OX'YZ$ ☐
8. What is radius of a sphere passing through the four points $(3, 2, 2), (-1, 1, 3), (0, 5, 6), (2, 1, 2)$ and centre $(1, 3, 4)$?
 - (a) 9 ☐
 - (b) $9/2$ ☐
 - (c) 3 ☐
 - (d) 1 ☐
9. The YZ plane divides the line joining the points $(2, 4, 5), (3, 5, -4)$ in the ratio
 - (a) 2 : 3 ☐
 - (b) 1 : 2 ☐
 - (c) -2 : 3 ☐
 - (d) 4 : 9 ☐
10. What are the coordinates of the centroid of the triangle whose vertices are $(3, 2, 0), (5, 3, 2)$ and $(-9, 6, -3)$?
 - (a) $\left(\frac{17}{3}, \frac{11}{3}, \frac{5}{3}\right)$ ☐
 - (b) $\left(-\frac{1}{3}, \frac{11}{3}, -\frac{1}{3}\right)$ ☐
 - (c) $(-1, 11, -1)$ ☐
 - (d) $(-17, 11, -5)$ ☐
11. Tetrahedron is bounded by how many planes ? ☐

(a) 3 ☐(b) 4 ☐(c) 6 ☐(d) 8 ☐

12. What is the number of the edges of a tetrahedron ?

(a) 3 ☐(b) 4 ☐(c) 6 ☐(d) 8 ☐

13. In a tetrahedron, each of the four vertices is the intersection of

(a) 2 planes ☐(b) 3 planes ☐(c) 2 straight lines ☐(d) 3 straight lines ☐

14. The point of intersection of the lines drawn from the vertices of any tetrahedron to the centroids of the opposite faces divides the distance from each vertex to the opposite face in which of the following ratios ?

(a) 3 : 1 ☐(b) 3 : 4 ☐(c) 2 : 1 ☐(d) 2 : 3 ☐15. If α, β, γ are the angles that a line makes with the positive direction of the co-ordinate axis, then the direction cosines of the line are(a) $\sin \alpha, \sin \beta, \sin \gamma$ ☐(b) $\sin \left(\frac{\pi}{2} - \alpha \right), \sin \left(\frac{\pi}{2} - \beta \right), \sin \left(\frac{\pi}{2} - \gamma \right)$ ☐(c) $\sin \alpha, \cos \beta, \sin \gamma$ ☐(d) $\cos \alpha, \sin \beta, \cos \gamma$ ☐16. If l, m, n are the direction cosines of a line, then(a) $l+m+n=0$ ☐(b) $l^2+m^2+n^2=1$ ☐(c) $\sqrt{l^2+m^2}+\sqrt{m^2+n^2}+\sqrt{n^2+l^2}=1$ ☐(d) $l^2+m^2+n^2=1/2$ ☐17. If the direction cosines l, m, n of a line are proportional to a, b, c , then(a) $l = \frac{\pm a}{\sqrt{\Sigma a^2}}, m = \frac{\pm b}{\sqrt{\Sigma a^2}}, n = \frac{\pm c}{\sqrt{\Sigma a^2}}$ ☐(b) $l = \frac{\pm a}{b^2+c^2}, m = \frac{\pm b}{c^2+a^2}, n = \frac{\pm c}{a^2+b^2}$ ☐(c) $l = \frac{b}{c}, m = \frac{c}{a}, n = \frac{a}{b}$ ☐(d) None of the above ☐18. Let α, β, γ be the angles that a line makes with x -axis, y -axis, z -axis respectively. Which of the following relations does not hold ?(a) $\cos^2 \alpha + \cos^2 \beta + \cos^2 \gamma = 1$ ☐(b) $\sin^2 \alpha + \sin^2 \beta + \sin^2 \gamma = 1$ ☐(c) $\sin^2 \alpha + \sin^2 \beta + \sin^2 \gamma = 2$ ☐(d) $\cos^2 \alpha + \cos^2 \beta - \sin^2 \gamma = 0$ ☐

19. The direction cosines of a line that makes equal angles with the axes are given by

(a) $\frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}$ ☐(b) $\frac{1}{\sqrt{3}}, -\frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}$ ☐(c) $\frac{1}{\sqrt{3}}, -\frac{1}{\sqrt{3}}, -\frac{1}{\sqrt{3}}$ ☐(d) All of the above ☐20. The projection of a line segment AB on CD , where θ is the angle between AB and CD , is given by(a) $AB \sin \theta$ ☐(b) $CD \cos \theta$ ☐(c) $CD \sin \theta$ ☐(d) $AB \cos \theta$ ☐21. Sum of the projections of all the segments $P_1P_2, P_2P_3, \dots, P_{n-1}P_n$ of a broken continuous line on CD , is equal to(a) Projection of P_1P_n on CD ☐(b) Projection of any of the segments on CD ☐(c) Sum of the lengths of the segments ☐(d) Sum of the squares of the lengths of the segments ☐

22. The length of a line whose projections on the axes are 12, 4, 3, is equal to

(a) 7 ☐(b) 13 ☐

(c) 15 ☐(d) 16 ☐

23. In Q. 22, the direction cosines of the line are given by

(a) $\frac{12}{7}, \frac{4}{7}, \frac{3}{7}$ ☐

(b) $\frac{3}{4}, \frac{1}{4}, \frac{3}{16}$ ☐

(c) $\frac{4}{5}, \frac{4}{15}, \frac{1}{5}$ ☐

(d) $\frac{12}{13}, \frac{4}{13}, \frac{3}{13}$ ☐

24. Direction ratios of the line joining the points (4, 3, -5) and (-2, 1, -8) are given by

(a) $\frac{6}{7}, \frac{2}{7}, \frac{3}{7}$ ☐

(b) 6, 2, 3 ☐

(c) 2, 4, -13 ☐

(d) 3, 1, $\frac{3}{2}$ ☐

25. Projection of a line joining the points (6, 3, 2) and (5, 1, 4) on the line joining (3, -4, 7) and (0, 2, 5) is equal to

(a) $-\frac{13}{3}$ ☐

(b) $-\frac{13}{7}$ ☐

(c) $\frac{13}{7}$ ☐

(d) $\frac{13}{3}$ ☐

26. The angle between the two lines, whose direction cosines are given by l_1, m_1, n_1 and l_2, m_2, n_2 respectively, is given by

(a) $\cos^{-1} \{(l_1 - l_2)^2 + (m_1 - m_2)^2 + (n_1 - n_2)^2\}$ ☐

(b) $\sin^{-1} \{(m_1 n_2 - m_2 n_1)^2 + (n_1 l_2 - n_2 l_1)^2 + (l_1 m_2 - l_2 m_1)^2\}$ ☐

(c) $\cos^{-1} (l_1 l_2 + m_1 m_2 + n_1 n_2)$ ☐

(d) $\cos^{-1} \sqrt{\{(m_1 n_2 - m_2 n_1)^2 + (n_1 l_2 - n_2 l_1)^2 + (l_1 m_2 - l_2 m_1)^2\}}$ ☐

27. Two lines whose direction cosines are given by l_1, m_1, n_1 and l_2, m_2, n_2 are perpendicular if

(a) $l_1 l_2 + m_1 m_2 + n_1 n_2 = 1$ ☐

(b) $\frac{l_1}{l_2} = \frac{m_1}{m_2} = \frac{n_1}{n_2}$ ☐

(c) $(l_1 + m_1 + n_1) + (l_2 + m_2 + n_2) = 0$ ☐

(d) $l_1 l_2 + m_1 m_2 + n_1 n_2 = 0$ ☐

28. The three concurrent lines, whose direction cosines are given by l_1, m_1, n_1 ; l_2, m_2, n_2 ; l_3, m_3, n_3 ; are coplanar if

(a) $\begin{vmatrix} l_1 & m_1 & n_1 \\ l_2 & m_2 & n_2 \\ l_3 & m_3 & n_3 \end{vmatrix} = 0$ ☐

(b) $\begin{vmatrix} l_1 & m_1 & n_1 \\ l_2 & m_2 & n_2 \\ l_3 & m_3 & n_3 \end{vmatrix} = 1$ ☐

(c) $l_1(m_2 n_3 + m_3 n_2) + m_1(l_2 n_3 + l_3 n_2) + n_1(l_2 m_3 + l_3 m_2) = 0$ ☐

(d) $l_1(m_2 m_3 + n_2 n_3) + l_2(m_1 m_3 + n_1 n_3) + l_3(m_1 m_2 + n_1 n_2) = 0$ ☐

29. The direction cosines of the line which is perpendicular to the lines whose direction ratios are (1, -2, -2) and (0, 2, 1), are given by

(a) $\frac{2}{3}, \frac{1}{3}, \frac{2}{3}$ ☐

(b) 1, -4, -3 ☐

(c) 2, 1, 2 ☐

(d) $\frac{2}{3}, \frac{-1}{3}, \frac{2}{3}$ ☐

30. The condition that a line makes angles $\alpha, \beta, \gamma, \delta$ with the four diagonals of a cube is that

(a) $\sin^2 \alpha + \sin^2 \beta + \sin^2 \gamma + \sin^2 \delta = \frac{4}{3}$ ☐

(b) $\cos^2 \alpha + \cos^2 \beta + \cos^2 \gamma + \cos^2 \delta = \frac{8}{3}$ ☐

(c) $\sin^2 \alpha + \sin^2 \beta + \sin^2 \gamma + \sin^2 \delta = \frac{8}{3}$ ☐

(d) $\cos^2 \alpha + \cos^2 \beta + \cos^2 \gamma + \cos^2 \delta = \frac{8}{3}$ ☐

31. The angle between the two diagonals of a cube are

(a) $\cos^{-1} \left(\frac{1}{\sqrt{3}} \right)$ ☐

(b) $\cos^{-1} \left(\frac{-1}{\sqrt{3}} \right)$ ☐

(c) $\cos^{-1} \left(\frac{-1}{3} \right)$ ☐

(d) $\cos^{-1} \left(\frac{1}{3} \right)$ ☐

32. If

$\left(\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}, 0 \right)$ and $\left(\frac{-2}{3}, \frac{2}{3}, \frac{-1}{3} \right)$

are the D -cosines of two mutually perpendicular lines, then the D -ratios of the line which is perpendicular to both of them are given by

(a) $-1, 1, 4$ ☐

(b) $1, -1, 4$ ☐

(c) $1, 1, -4$ ☐

(d) $-1, -1, 4$ ☐

33. Let the coordinates of three points A, B, C be given by $(1, 8, 4), (0, -11, 4), (2, -3, 1)$ respectively. Then the coordinates of a point D which is the foot of the perpendicular from A on BC , are given by

(a) $(4, -5, 2)$ ☐

(b) $(5, 4, -2)$ ☐

(c) $(4, 5, -2)$ ☐

(d) $(-4, 5, 2)$ ☐

34. The four points $(0, 4, 1), (2, 3, -1), (4, 5, 0), (2, 6, 2)$ are the vertices of a

(a) Rhombus ☐

(b) Rectangle ☐

(c) Square ☐

(d) Parallelogram ☐

35. Let $A(3, 2, 0), B(5, 3, 2), C(-9, 6, -3)$ be the three points forming a triangle. Let the bisector of the angle BAC meet BC in D . Then D divides BC in the ratio of

(a) $3 : 13$ ☐

(b) $3 : 16$ ☐

(c) $\sqrt{33} : 16$ ☐

(d) $13 : 3$ ☐

36. Let $A(-1, 2, -3), B(5, 0, -6), C(0, 4, -1)$ be the three points. Then the direction cosines of the internal bisector of the angle BAC are proportional to

(a) $(25, 8, 5)$ ☐

(b) $(-11, 20, 23)$ ☐

(c) $(7, -6, -9)$ ☐

(d) None of the above ☐

37. Which of the following is incorrect? If $l_1, m_1, n_1; l_2, m_2, n_2; l_3, m_3, n_3$ be the D -cosines of three mutually perpendicular lines, then

(a) $l_1 l_2 + m_1 m_2 + n_1 n_2 = 0$ ☐

(b) $l_1^2 + l_2^2 + l_3^2 = 1$ ☐

(c) $l_1^2 + m_1^2 + n_1^2 = 1$ ☐

(d) None of the above ☐

38. The direction ratios of the line, which is equally inclined to the three mutually perpendicular lines with D -cosines $l_1, m_1, n_1; l_2, m_2, n_2; l_3, m_3, n_3$ are given by

(a) $l_1 + m_1 + n_1; l_2 + m_2 + n_2; l_3 + m_3 + n_3$ ☐

(b) $l_1 + l_2 + l_3; m_1 + m_2 + m_3; n_1 + n_2 + n_3$ ☐

(c) $m_1 n_2 - m_2 n_1; n_1 l_2 - n_2 l_1; l_1 m_2 - l_2 m_1$ ☐

(d) None of the above ☐

39. "If O, A, B, C be the four points not lying in the same plane such that $OA \perp BC, OB \perp CA$, then $OC \perp AB$." If the points O, A, B, C are coplanar, then the above result reduces to

(a) The altitudes drawn from the vertices of a triangle on opposite sides are concurrent ☐

(b) The medians of a triangle are concurrent ☐

(c) The right bisectors of the angles of a triangle are concurrent ☐

(d) None of the above ☐

40. If a_1, b_1, c_1 and a_2, b_2, c_2 are the D -ratios of two lines, then the angle between them is not given by

(a) $\cos^{-1} \frac{a_1 a_2 + b_1 b_2 + c_1 c_2}{\sqrt{(a_1^2 + b_1^2 + c_1^2)(a_2^2 + b_2^2 + c_2^2)}}$ ☐

(b) $\sin^{-1} \frac{\sqrt{\Sigma (a_1 b_2 - a_2 b_1)^2}}{\sqrt{\Sigma a_1^2} \sqrt{\Sigma a_2^2}}$ ☐

(c) $\tan^{-1} \frac{\sqrt{\Sigma (a_1 b_2 - a_2 b_1)^2}}{\sqrt{\Sigma a_1^2} \sqrt{\Sigma a_2^2}}$ ☐

(d) $\tan^{-1} \frac{\sqrt{\Sigma (a_1 b_2 - a_2 b_1)^2}}{\Sigma a_1 a_2}$ ☐

41. If the edges of a rectangular parallelepiped are OA, OB and OC along coordinate axes such that $OA=a, OB=b, OC=c$ and PL, PM and PN are the perpendiculars drawn from $P(a, b, c)$ on XY, ZX and YZ planes respectively, then angle between OP and AN is given by

(a) $\cos^{-1} \left(\frac{a^2 - b^2 + c^2}{\Sigma a^2} \right)$ ☐

(b) $\cos^{-1} \left(\frac{-a^2 + b^2 + c^2}{\Sigma a^2} \right)$ ☐

(c) $\cos^{-1} \left(\frac{a^2 + b^2 + c^2}{\Sigma a^2} \right)$ ☐

(d) $\cos^{-1} \left(\frac{-a^2 - b^2 + c^2}{\Sigma a^2} \right)$ ☐

42. If a variable line in two adjacent positions has direction cosines as l, m, n ; $l + \delta l, m + \delta m, n + \delta n$, then the small angle $\delta\theta$ between those two positions is given by

(a) $\sqrt{\delta l^2 + \delta m^2 + \delta n^2}$ ☐

(b) $\delta l^2 + \delta m^2 + \delta n^2$ ☐

(c) $\delta l + \delta m + \delta n$ ☐

(d) $\sqrt{\Sigma (\delta l - \delta m)^2}$ ☐

43. The area of the triangle with vertices $(0, 0, 0)$, $(0, b, 0)$ and $(0, 0, c)$ is given by

(a) bc ☐

(b) $\frac{1}{2} bc$ ☐

(c) 0 ☐

(d) $\frac{1}{8} bc$ ☐

44. The area of the triangle ABC formed by the intercepts $OA=a$, $OB=b$, $OC=c$ on the coordinate axes respectively by a plane, is given by

(a) $\sqrt{\Sigma a^2 b^2}$ ☐

(b) $\frac{1}{2} \sqrt{\Sigma a(b^2 - c^2)}$ ☐

(c) $\frac{1}{2} \sqrt{\Sigma a^2 b^2}$ ☐

(d) None of the above ☐

45. If two pairs of opposite edges of a tetrahedron are at right angles, then the third pair

(a) Is also at right angles always ☐

(b) Can never be at right angles ☐

(c) Is inclined at some acute angle ☐

(d) Is inclined at some obtuse angle ☐

46. If the pairs of opposite edges of a tetrahedron $OABC$ are at right angles, then

(a) $OA^2 + BC^2 = OB^2 + CA^2$ ☐

(b) $OA^2 + BC^2 = OC^2 + AB^2$ ☐

(c) $OB^2 + CA^2 = OC^2 + AB^2$ ☐

(d) All of the above ☐

47. How many arbitrary constants are there in the equation of a plane ?

(a) 2 ☐

(b) 3 ☐

(c) 4 ☐

(d) Any finite number ☐

48. The equation of which of the following degrees in x, y, z represents a plane ?

(a) 1 ☐

(b) 2 ☐

(c) Any odd natural number ☐

(d) 3 ☐

49. Which one of the following is the equation of the plane which meets the coordinate axes in A, B, C such that the centroid of the triangle ABC is (a, b, c) ?

(a) $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$ ☐

(b) $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 2$ ☐

(c) $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 3$ ☐

(d) $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 4$ ☐

50. If l, m, n are the direction of the normal to the plane and p be the perpendicular distance from the origin on it, then the equation of the plane is of the type

(a) $\frac{x}{l} + \frac{y}{m} + \frac{z}{n} = p$ ☐

(b) $lx + my + nz = \frac{1}{p}$ ☐

(c) $lx + my + nz = p$ ☐

(d) $lx + my + nz = \sqrt{p}$ ☐

51. The equation of the plane passing through the point $A(a, b, c)$ and perpendicular to OA (O being origin) is given by

(a) $ax + by + cz = a^2 + b^2 + c^2$ ☐

(b) $a(x-a) + b(y-b) + c(z-c) = 0$ ☐

(c) $a(x-a) + b(y-b) + c(z-c) = \sqrt{a^2 + b^2 + c^2}$ ☐

(d) Both (a) and (b) above ☐

52. The equation of the plane passing through $(2, -3, 1)$ and perpendicular to the

line joining the points (3, 4, -1) and (2, -1, 5) is given by

- (a) $5x+3y+4z-5=0$ ☐
 (b) $x+5y-6z+19=0$ ☐
 (c) $5x+3y+4z+5=0$ ☐
 (d) $x+5y-6z-19=0$ ☐

53. The equation of the plane through the points (2, 3, 1) and (-4, 5, 3) and parallel to x-axis is given by

- (a) $x-z-1=0$ ☐
 (b) $4x+y-11=0$ ☐
 (c) $y+4z-7=0$ ☐
 (d) $6x-2y-2z+4=0$ ☐

54. The distance of the plane

$$6x-3y+z+2z-14=0$$

from the origin is

- (a) 2 ☐
 (b) 14 ☐
 (c) -14 ☐
 (d) 7 ☐

55. In the equation of the plane given by $ax+by+cz+d=0$; a, b, c denote the

- (a) D-cosines of the normal to the plane ☐
 (b) D-ratios of the normal to the plane ☐
 (c) D-cosines of any line on the plane ☐
 (d) D-cosines of a line parallel to the plane ☐

56. The angle between the two planes is same as the angle between

- (a) Any line in one plane and any line in another plane ☐
 (b) The normal to one plane and any line in another plane ☐
 (c) Their normals ☐
 (d) The two lines parallel to them ☐

57. The angle between the two planes

$$ax+by+cz+d=0$$

and $a'x+b'y+c'z+d'=0$ is given by

- (a) $\cos^{-1} \left(\frac{\Sigma aa'}{\Sigma a^2 \Sigma b^2} \right)$ ☐
 (b) $\sin^{-1} \frac{\sqrt{\Sigma(bc'-b'c)^2}}{\Sigma a^2 \Sigma b^2}$ ☐

(c) $\tan^{-1} \frac{\sqrt{\Sigma(bc'-b'c)^2}}{\Sigma a^2 \Sigma b^2}$ ☐

(d) None of the above ☐

58. The two planes $ax+by+cz+d=0$ and $a'x+b'y+c'z+d'=0$ are perpendicular if

(a) $aa'+bb'+cc'+dd'=0$ ☐

(b) $\frac{a}{a'} + \frac{b}{b'} + \frac{c}{c'} + \frac{d}{d'} = 0$ ☐

(c) $\frac{a}{a'} = \frac{b}{b'} = \frac{c}{c'}$ ☐

(d) $aa'+bb'+cc'=0$ ☐

59. The planes

$$2x-y+z=16$$

and $x+y+2z=3$

are inclined at an angle of

(a) $\frac{\pi}{2}$ ☐

(b) $\frac{\pi}{3}$ ☐

(c) $\cos^{-1} \left(\frac{1}{\sqrt{3}} \right)$ ☐

(d) π ☐

60. Which one of the following is incorrect?

The condition that the four points

$(x_1, y_1, z_1), (x_2, y_2, z_2), (x_3, y_3, z_3)$ and (x_4, y_4, z_4) are coplanar is

(a)
$$\begin{vmatrix} 1 & 1 & 1 & 1 \\ x_1 & x_2 & x_3 & x_4 \\ y_1 & y_2 & y_3 & y_4 \\ z_1 & z_2 & z_3 & z_4 \end{vmatrix} = 0$$
 ☐

(b)
$$\begin{vmatrix} x & y & z & 1 \\ x_1 & x_2 & x_3 & x_4 \\ y_1 & y_2 & y_3 & y_4 \\ z_1 & z_2 & z_3 & z_4 \end{vmatrix} = 0$$
 ☐

(c)
$$\begin{vmatrix} 1 & 1 & 1 & 1 \\ x_1 & x_2 & x_3 & x_4 \\ y_1 & y_2 & y_3 & y_4 \\ z_1 & z_2 & z_3 & z_4 \end{vmatrix} = 0$$
 ☐

(d)
$$\begin{vmatrix} 1 & 1 & 1 & 1 \\ x_1 & x_2 & x_3 & x_4 \\ y_1 & y_2 & y_3 & y_4 \\ z_1 & z_2 & z_3 & z_4 \end{vmatrix} = 0$$
 ☐

$$(d) \begin{vmatrix} z_1 & z_2 & z_3 & z_4 \\ y_1 & y_2 & y_3 & y_4 \\ 1 & 1 & 1 & 1 \\ x_1 & x_2 & x_3 & x_4 \end{vmatrix} = 0 \quad \square$$

61. Which of the following statements is incorrect?

Two points $P(x_1, y_1, z_1)$ and $Q(x_2, y_2, z_2)$ lie on the same side of the plane

$$ax+by+cz+d=0 \text{ if}$$

- (a) $ax_1+by_1+cz_1+d$ and $ax_2+by_2+cz_2+d$ are both positive ☐
- (b) $ax_1+by_1+cz_1+d$ and $ax_2+by_2+cz_2+d$ are both negative ☐
- (c) $ax_1+by_1+cz_1+d=ax_2+by_2+cz_2+d=\lambda\mu$ ($\lambda > 0, \mu < 0$) ☐
- (d) $ax_1+by_1+cz_1+d$ and $ax_2+by_2+cz_2+d$ are of opposite signs ☐

62. The two points $(1, 1, 1)$ and $(-3, 0, 1)$ from the plane $3x+4y-12z+13=0$ are

- (a) Equidistant from it and lie on the same side of it ☐
- (b) Not equidistant from it and lie on the same side of it ☐
- (c) Not equidistant from it and lie on opposite sides of it ☐
- (d) Equidistant from it and lie on the opposite sides of it ☐

63. If $D > 0$, then the length of the perpendicular from the origin on the plane

$$Ax+By+Cz+D=0 \text{ is}$$

- (a) $\frac{D}{\sqrt{A^2+B^2+C^2+D^2}}$ ☐
- (b) $\frac{-D}{A^2+B^2+C^2+D^2}$ ☐
- (c) $\frac{D}{\sqrt{A^2+B^2+C^2}}$ ☐
- (d) $\frac{-D}{\sqrt{A^2+B^2+C^2}}$ ☐

64. The distance of the point $(2, 3, 4)$ from the plane $3x-6y+2z+11=0$ is

- (a) 1 ☐
- (b) $\frac{43}{\sqrt{7}}$ ☐

$$(c) \frac{1}{49} \quad \square$$

$$(d) \frac{-1}{49} \quad \square$$

65. The distance between the parallel planes $2x-2y+z+3=0$ and $4x-4y+2z+5=0$ is

- (a) $\frac{1}{2}$ ☐
- (b) $\frac{1}{3}$ ☐
- (c) $\frac{1}{6}$ ☐
- (d) None of the above ☐

66. The equation

$$ax^2+by^2+cz^2+2fyz+2gzx+2hxy=0$$

represents a pair of planes if

- (a) $abc+2fgh-af^2-bg^2-ch^2=0$ ☐
- (b) $abc+2fgh+af^2+bg^2+ch^2=0$ ☐
- (c) $f^2+g^2+h^2-bc-ca-ab=0$ ☐
- (d) $f^2+g^2+h^2+bc+ca+ab=0$ ☐

67. The two planes represented by

$$ax^2+by^2+cz^2+2fyz+2gzx+2hxy=0$$

are perpendicular if

- (a) $abc+2fgh+af^2+bg^2+ch^2=0$ ☐
- (b) $af+bg+ch=0$ ☐
- (c) $a+b+c=0$ ☐
- (d) $f^2+g^2+h^2-bc-ca-ab=0$ ☐

68. Which of the following equations represent pair of perpendicular planes?

- (a) $2x^2-2y^2+4z^2-2yz+6xz+3xy=0$ ☐
- (b) $6x^2+4y^2-10z^2+3yz+4zx-11xy=0$ ☐
- (c) $12x^2-2y^2-6z^2+7yz+6zx-2xy=0$ ☐
- (d) $2x^2-y^2+2z^2-yz+5zx+xy=0$ ☐

69. The equation of the bisector of the angle between two planes $a_1x+b_1y+c_1z+d_1=0$ and $a_2x+b_2y+c_2z+d_2=0$ containing the origin is given by

$$\frac{a_1x+b_1y+c_1z+d_1}{\sqrt{a_1^2+b_1^2+c_1^2}} = \frac{a_2x+b_2y+c_2z+d_2}{\sqrt{a_2^2+b_2^2+c_2^2}}$$

provided

- (a) $d_1d_2=0$ ☐
- (b) $d_1d_2>0$ ☐
- (c) $d_1d_2<0$ ☐
- (d) $d_1<d_2$ ☐

70. $14x-8y+13=0$ is the equation of bisector of the angle between the planes

$$3x+4y+5z+1=0, \quad 5x+12y-13z=0$$

- (a) Containing the origin and bisecting the obtuse angle ☐
 (b) Containing the origin and bisecting the acute angle ☐
 (c) Not containing the origin and bisecting the obtuse angle ☐
 (d) Not containing the origin and bisecting the acute angle ☐

71. The volume of the tetrahedron the coordinates of whose vertices are (x_1, y_1, z_1) , (x_2, y_2, z_2) , (x_3, y_3, z_3) and (x_4, y_4, z_4) is given by

$$k \begin{vmatrix} x_1 & y_1 & z_1 & 1 \\ x_2 & y_2 & z_2 & 1 \\ x_3 & y_3 & z_3 & 1 \\ x_4 & y_4 & z_4 & 1 \end{vmatrix}$$

where k is equal to

- (a) $\frac{1}{6}$ ☐
 (b) $\frac{1}{3}$ ☐
 (c) $\frac{1}{6}$ ☐
 (d) $\frac{1}{12}$ ☐

72. A straight line is represented by— equations of the first degree in x, y, z

- (a) Two ☐
 (b) One ☐
 (c) Infinite ☐
 (d) None of the above ☐

73. A given line can be represented by how many pairs of first degree equations in x, y, z ?

- (a) One only ☐
 (b) At the most two ☐
 (c) Two only ☐
 (d) Infinite ☐

74. The equation of a straight line passing through the point (x_1, y_1, z_1) having direction cosines as l, m, n ; is given by

- (a) $\frac{x_1}{l} = \frac{y_1}{m} = \frac{z_1}{n}$ ☐
 (b) $l(x-x_1) = m(y-y_1) = n(z-z_1)$ ☐
 (c) $\frac{x-x_1}{l} = \frac{y-y_1}{m} = \frac{z-z_1}{n}$ ☐
 (d) All of the above ☐

75. If the lines

$$\frac{x-1}{-3} = \frac{y-2}{2k} = \frac{z-3}{2} \text{ and } \frac{x-1}{3k} = \frac{y-5}{1} = \frac{z-6}{-5}$$

are perpendicular to each other, then k is equal to

- (a) $\frac{10}{7}$ ☐
 (b) $\frac{7}{10}$ ☐
 (c) $\frac{10}{11}$ ☐
 (d) $\frac{-10}{7}$ ☐

76. What are the coordinates of the point of intersection of the line

$$\frac{x+1}{1} = \frac{y+3}{3} = \frac{z-2}{-2}$$

with the plane $3x+4y+5z=5$?

- (a) $(1, 3, 2)$ ☐
 (b) $(1, 3, -2)$ ☐
 (c) $(-1, 3, 2)$ ☐
 (d) $(-1, -3, 2)$ ☐

77. The distance of the point $(-1, -3, 2)$ on the line

$$\frac{x+1}{1} = \frac{y+3}{3} = \frac{z-2}{-2}$$

from any other point on the line is equal to

- (a) 2 ☐
 (b) $\sqrt{56}$ ☐
 (c) $\sqrt{28}$ ☐
 (d) $\sqrt{14}$ ☐

78. The straight line passing through (a, b, c) and parallel to the z -axis is given by

- (a) $\frac{x-a}{1} = \frac{y-b}{1} = \frac{z-c}{0}$ ☐
 (b) $\frac{x-a}{0} = \frac{y-b}{1} = \frac{z-c}{1}$ ☐
 (c) $\frac{x-a}{0} = \frac{y-b}{0} = \frac{z-c}{1}$ ☐
 (d) $\frac{x-a}{1} = \frac{y-b}{0} = \frac{z-c}{0}$ ☐

79. The straight line passing through (a, b, c) and perpendicular to x -axis is given by

$$(a) \frac{x-a}{l} = \frac{y-b}{o} = \frac{z-c}{n}$$

$$(b) \frac{y-a}{l} = \frac{y-b}{m} = \frac{z-c}{o}$$

$$(c) \frac{x-a}{l} = \frac{y-b}{o} = \frac{z-c}{o}$$

$$(d) \frac{x-a}{o} = \frac{y-b}{m} = \frac{z-c}{n}$$

80. To transform the equations of a line from unsymmetrical form to the symmetrical form, it is necessary to know about

(a) The D -ratios of the line ☐

(b) The coordinates of any one point on it ☐

(c) The coordinates of any two points on it and its D -ratios ☐

(d) Its direction ratios and the coordinates of any one point on it only ☐

81. The equations of the line through the point (1, 2, 4) and parallel to the line

$$3x+2y-z=4, x-2y-2z=5$$

is given by

$$(a) \frac{x-1}{6} = \frac{2-y}{5} = \frac{z-4}{8}$$

$$(b) \frac{x-1}{2} = \frac{y-2}{4} = \frac{z-4}{1}$$

$$(c) \frac{x-1}{4} = \frac{y-2}{0} = \frac{z-4}{-3}$$

$$(d) \frac{x+1}{6} = \frac{2+y}{5} = \frac{z+4}{8}$$

82. The angle between the lines in which the planes $3x-7y-5z=1$ and

$$5x-13y+3z+2=0$$

cut the plane $8x-11y+2z=0$, is equal to

$$(a) 0$$

$$(b) \frac{\pi}{3}$$

$$(c) \frac{\pi}{2}$$

$$(d) \frac{\pi}{6}$$

83. The angle between the line

$$\frac{x-x_1}{l} = \frac{y-y_1}{m} = \frac{z-z_1}{n}$$

and the plane $ax+by+cz+d=0$, is given by

$$(a) \cos^{-1} \left(\frac{al+bm+cn}{\sqrt{\Sigma a^2} \sqrt{\Sigma l^2}} \right)$$

$$(b) \sin^{-1} \left(\frac{\sqrt{\Sigma (bn-cn)^2}}{\sqrt{\Sigma a^2} \sqrt{\Sigma l^2}} \right)$$

$$(c) \sin^{-1} \left(\frac{al+bm+cn}{\sqrt{\Sigma a^2} \sqrt{\Sigma l^2}} \right)$$

$$(d) \sin^{-1} \left(\frac{\sqrt{(bn-cn)^2}}{al+bm+cn} \right)$$

84. If the straight line

$$\frac{x-x_1}{l} = \frac{y-y_1}{m} = \frac{z-z_1}{n}$$

is parallel to the plane

$$ax+by+cz+d=0, \text{ then}$$

$$(a) \frac{a}{l} = \frac{b}{m} = \frac{c}{n}$$

$$(b) al+bm+cn=0$$

$$(c) a+b+c=0$$

$$(d) l+m+n=0$$

85. Which of the following is/are the condition(s) that the line

$$\frac{x-x_1}{l} = \frac{y-y_1}{m} = \frac{z-z_1}{n}$$

may lie in the plane

$$ax+by+cz+d=0$$

$$(a) al+bm+cn=0 \text{ only}$$

$$(b) ax_1+by_1+cz_1+d=0 \text{ only}$$

(c) The normal to the plane must be perpendicular to the line and any one point on the line lies in the plane

(d) None of the above

86. Which of the following lines lies in the plane $x+2y+3z=6$?

$$(a) \frac{x+10}{1} = \frac{8-y}{2} = \frac{z}{1}$$

$$(b) \frac{x-2}{-10} = \frac{y+2}{-1} = \frac{z-3}{4}$$

$$(c) \frac{x+2}{6} = \frac{y+3}{3} = \frac{4-z}{4}$$

$$(d) \frac{x-1}{4} = \frac{y+6}{-4} = \frac{z+1}{4/3}$$

87. Which of the following statements is incorrect?

(a) The lines $\frac{x-\alpha_1}{l_1} = \frac{y-\beta_1}{m_1} = \frac{z-\gamma_1}{n_1}$
and $\frac{x-\alpha_2}{l_2} = \frac{y-\beta_2}{m_2} = \frac{z-\gamma_2}{n_2}$

are coplanar if

$$\begin{vmatrix} \alpha_2 - \alpha_1 & \beta_2 - \beta_1 & \gamma_2 - \gamma_1 \\ l_1 & m_1 & n_1 \\ l_2 & m_2 & n_2 \end{vmatrix} = 0 \quad \square$$

(b) The lines $\frac{x-\alpha}{l} = \frac{y-\beta}{m} = \frac{z-\gamma}{n}$

and $ax+by+cz+d=0$

$=a'x+b'y+c'z+d'$

are coplanar if

$$\frac{a\alpha+b\beta+c\gamma+d}{la+mb+nc} = \frac{a'\alpha+b'\beta+c'\gamma+d'}{la'+mb'+nc'} \quad \square$$

(c) The lines

$ax+by+cz+d=0=a'x+b'y+c'z+d'$

and

$\alpha x+\beta y+\gamma z+\delta=0=\alpha'x+\beta'y+\gamma'z+\delta'$

are coplanar if

$$\begin{vmatrix} a & b & c & d \\ a' & b' & c' & d' \\ \alpha & \beta & \gamma & \delta \\ \alpha' & \beta' & \gamma' & \delta' \end{vmatrix} = 0 \quad \square$$

(d) Only one of the above conditions does not hold ☐

88. The equation of the plane passing through the point (x_1, y_1, z_1) and through the line $\frac{x-\alpha}{l} = \frac{y-\beta}{m} = \frac{z-\gamma}{n}$ is given by

(a) $\begin{vmatrix} x-\alpha & y-\beta & z-\gamma \\ l & m & n \\ x_1 & y_1 & z_1 \end{vmatrix} = 0 \quad \square$

(b) $\begin{vmatrix} x-\alpha & y-\beta & z-\gamma \\ l & m & n \\ x & y & z \end{vmatrix} = 0 \quad \square$

(c) $\begin{vmatrix} x_1-\alpha & y_1-\beta & z_1-\gamma \\ x-\alpha & y-\beta & z-\gamma \\ l & m & n \end{vmatrix} = 0 \quad \square$

(d) None of the above ☐

89. The equation of the plane containing the lines

$$\frac{x-a}{a'} = \frac{y-b}{b'} = \frac{z-c}{c'} \quad \text{and} \quad \frac{x-a'}{a} = \frac{y-b'}{b} = \frac{z-c'}{c}$$

is not given by

(a) $\begin{vmatrix} x & y & z \\ a' & b' & c' \\ a & b & c \end{vmatrix} = 0 \quad \square$

(b) $\begin{vmatrix} x-a & y-b & z-c \\ a & b & c \\ a' & b' & c' \end{vmatrix} = 0 \quad \square$

(c) $\begin{vmatrix} x-a & y-b & z-c \\ a' - a & b' - b & c' - c \\ a & b & c \end{vmatrix} = 0 \quad \square$

(a) $\begin{vmatrix} x-a & y-b & z-c \\ a' - a & b' - b & c' - c \\ a' & b' & c' \end{vmatrix} = 0 \quad \square$

90. How many arbitrary constants occur in the equation of a straight line in general ?

- (a) 3 ☐
(b) 4 ☐
(c) 6 ☐
(d) 8 ☐

91. The equations of the perpendicular drawn from the point $(2, 4, -1)$ to the line

$$\frac{x+5}{1} = \frac{y+3}{4} = \frac{z-9}{9}$$

are given by

(a) $\frac{x-2}{-4} = \frac{4-y}{-1} = \frac{z+1}{-3} \quad \square$

(b) $\frac{x-2}{6} = \frac{4-y}{-3} = \frac{z+1}{2} \quad \square$

(c) $\frac{x-2}{-3} = \frac{y-4}{1} = \frac{z+1}{5} \quad \square$

(d) None of the above ☐

92. What is the magnitude of the line of shortest distance between the lines

$$\frac{x-8}{3} = \frac{y+9}{-3} = \frac{z-10}{7}$$

and

$$\frac{x-15}{3} = \frac{y-29}{8} = \frac{z-5}{-5}$$

(a) $\sqrt{14}$ ☐

(b) 14 ☐

(c) 7 ☐

(d) 2 ☐

93. The equation of the line of shortest distance between the lines

$$\frac{x-3}{3} = \frac{y-8}{-1} = \frac{z-3}{1}$$

and

$$\frac{x+3}{-3} = \frac{y+7}{2} = \frac{z-6}{4}$$

is given by

(a) $\frac{x-3}{-3} = \frac{y-8}{2} = \frac{z-3}{4}$ ☐

(b) $\frac{x+3}{3} = \frac{y+7}{-1} = \frac{z-6}{1}$ ☐

(c) $\frac{x-3}{2} = \frac{y-8}{5} = \frac{z-3}{-1}$ ☐

(d) $\frac{x-3}{2} = \frac{y-8}{5} = \frac{z-3}{1}$ ☐

94. Which is a wrong statement? The three planes

$$a_1x + b_1y + c_1z + d_1 = 0$$

$$a_2x + b_2y + c_2z + d_2 = 0$$

$$a_3x + b_3y + c_3z + d_3 = 0$$

have a common line of intersection, if

(a) $\begin{vmatrix} a_1 & b_1 & c_1 & d_1 \\ a_2 & b_2 & c_2 & d_2 \\ a_3 & b_3 & c_3 & d_3 \end{vmatrix} = 0$ ☐

(b) $\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = 0$ and $\begin{vmatrix} a_1 & b_1 & d_1 \\ a_2 & b_2 & d_2 \\ a_3 & b_3 & d_3 \end{vmatrix} = 0$ only ☐

(c) $\begin{vmatrix} d_1 & b_1 & c_1 \\ d_2 & b_2 & c_2 \\ d_3 & b_3 & c_3 \end{vmatrix}, \begin{vmatrix} a_1 & d_1 & c_1 \\ a_2 & d_2 & c_2 \\ a_3 & d_3 & c_3 \end{vmatrix}$ and

$\begin{vmatrix} a_1 & b_1 & d_1 \\ a_2 & b_2 & d_2 \\ a_3 & b_3 & d_3 \end{vmatrix}$ all vanish ☐

(d) $\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}, \begin{vmatrix} d_1 & b_1 & c_1 \\ d_2 & b_2 & c_2 \\ d_3 & b_3 & c_3 \end{vmatrix}, \begin{vmatrix} a_1 & d_1 & c_1 \\ a_2 & d_2 & c_2 \\ a_3 & d_3 & c_3 \end{vmatrix}$ and $\begin{vmatrix} a_1 & b_1 & d_1 \\ a_2 & b_2 & d_2 \\ a_3 & b_3 & d_3 \end{vmatrix}$ all vanish ☐

all vanish ☐

95. Consider the three planes represented by

$$a_1x + b_1y + c_1z + d_1 = 0$$

$$a_2x + b_2y + c_2z + d_2 = 0$$

$$a_3x + b_3y + c_3z + d_3 = 0$$

Let $\Delta = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$; $\Delta_1 = \begin{vmatrix} d_1 & b_1 & c_1 \\ d_2 & b_2 & c_2 \\ d_3 & b_3 & c_3 \end{vmatrix}$

$\Delta_2 = \begin{vmatrix} a_1 & d_1 & c_1 \\ a_2 & d_2 & c_2 \\ a_3 & d_3 & c_3 \end{vmatrix}$; $\Delta_3 = \begin{vmatrix} a_1 & b_1 & d_1 \\ a_2 & b_2 & d_2 \\ a_3 & b_3 & d_3 \end{vmatrix}$

then the three planes will form a triangular prism if

(a) $\Delta = 0$ only ☐

(b) $\Delta = 0$ and $\Delta_3 = 0$ ☐

(c) $\Delta \neq 0, \Delta_1 \neq 0, \Delta_2 \neq 0, \Delta_3 \neq 0$ ☐

(d) $\Delta \neq 0, \Delta_1 = 0 = \Delta_2 = \Delta_3$ ☐

96. The three planes in Q. 95 will intersect in a unique finite point if

- (a) $\Delta=0$ only
 (b) $\Delta \neq 0, \Delta_1=0, \Delta_2=0, \Delta_3=0$
 (c) $\Delta \neq 0$ only
 (d) $\Delta=0$ but $\Delta_1 \neq 0, \Delta_2 \neq 0, \Delta_3 \neq 0$

97. The three planes

$$\begin{aligned} 2x+3y-z-2 &= 0 \\ 3x+3y+z-4 &= 0 \\ x-y+2z-5 &= 0 \end{aligned}$$

intersect in

- (a) A prism
 (b) A point
 (c) A line
 (d) None of the above

98. The planes $bx-ay=n, cy-bz=l, az-cx=m$ intersect in a line if

- (a) $a+b+c=0$
 (b) $a=b=c$
 (c) $al+bm+cn=0$
 (d) $l+m+n=0$

99. The equation

$$ax^2+ay^2+az^2+2ux+2vy+2wz+d=0 (a \neq 0)$$

represents a sphere if

- (a) $u^2+v^2+w^2-d \geq 0$
 (b) $u^2+v^2+w^2-ad \geq 0$
 (c) $u^2+v^2+w^2-d \leq 0$
 (d) $u^2+v^2+w^2-ad \leq 0$

100. The centre of the sphere

$$2x^2+2y^2+2z^2-2x+4y+2z+3=0$$

is

- (a) $(1, -2, -1)$
 (b) $(2, -4, -2)$
 (c) $(\frac{1}{2}, -1, -\frac{1}{2})$
 (d) $(-1, 2, 1)$

101. The radius of the sphere described on the join of $(2, -3, 4)$ and $(-5, 6, -7)$ as diameter is

- (a) $\sqrt{\frac{27}{2}}$
 (b) $\sqrt{251}$
 (c) $\sqrt{\frac{251}{2}}$
 (d) $\frac{\sqrt{251}}{2}$

102. The locus of the foot of the perpendicular drawn from the origin to a plane passing through a fixed point (a, b, c) is

- (a) $x^2+y^2+z^2-ax-by-cz=0$
 (b) $(x-a)^2+(y-b)^2+(z-c)^2+2a(x-a)+2b(y-b)+2c(z-c)=0$
 (c) $x^2+y^2+z^2=\sqrt{a^2+b^2+c^2}$
 (d) None of the above

103. A sphere of constant radius $2k$ passes through the origin and meets the axes in A, B, C . The locus of the centroid of tetrahedron $OABC$ is

- (a) $x^2+y^2+z^2=4k^2$
 (b) $x^2+y^2+z^2=16k^2$
 (c) $x^2+y^2+z^2=k^2$
 (d) $x^2+y^2+z^2=8k^2$

104. Which of the following statements is wrong?

The equation $x^2+y^2+z^2-ax-by-cz=0$ represents the

- (a) Locus of the foot of the perpendicular from the origin to a plane passing through a fixed point (a, b, c)
 (b) Sphere passing through the points $(0, 0, 0), (a, 0, 0), (0, b, 0), (0, 0, c)$
 (c) Sphere circumscribing the tetrahedron whose faces are $x=0, y=0, z=0, \frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$
 (d) Sphere passing through the four points $(0, 0, 0), (-a, b, c), (a, -b, c), (a, b, -c)$

105. A plane passes through a fixed point (a, b, c) and cuts the axes in A, B and C . Then the locus of the centre of the sphere passing through the origin and the points A, B, C is given by

- (a) $(x^2+y^2+z^2)-(a^2+b^2+c^2)(\frac{x}{a}+\frac{y}{b}+\frac{z}{c})=0$
 (b) $\frac{a}{x}+\frac{b}{y}+\frac{c}{z}=2$
 (c) $x^2+y^2+z^2=a^2+b^2+c^2$
 (d) $x^2+y^2+z^2-(a^2+b^2+c^2)(\frac{x}{a}+\frac{y}{b}+\frac{z}{c})=1$

106. Which of the following is a correct statement? The circle is

- (a) The locus of points common to sphere and a plane ☐
 (b) Curve of intersection of two spheres ☐
 (c) Both of (a) and (b) are correct ☐
 (d) None of (a) and (b) is correct ☐

107. The equations

$$x^2 + y^2 + z^2 + x + y + z - 4 = 0$$

$$\text{and } x + y + z = 0$$

represents a

- (a) Cone ☐
 (b) Straight line ☐
 (c) Plane ☐
 (d) Circle ☐

108. The condition that $lx + my + nz = p$ is a tangent plane to the sphere

$$x^2 + y^2 + z^2 + 2ux + 2vy + 2wz + d = 0 \text{ is}$$

- (a) $(lu + mv + nw)^2 = (u^2 + v^2 + w^2 - d)$ ☐
 (b) $(lu + mv + nw - p)^2 = (u^2 + v^2 + w^2 - d)$ ☐
 (c) $(lu + mv + nw - p)^2 = (l^2 + m^2 + n^2)(u^2 + v^2 + w^2)$ ☐
 (d) $(lu + mv + nw - p)^2 = (l^2 + m^2 + n^2)(u^2 + v^2 + w^2 - d)$ ☐

109. The two spheres

$$x^2 + y^2 + z^2 + 2u_1x + 2v_1y + 2w_1z + d_1 = 0$$

$$x^2 + y^2 + z^2 + 2u_2x + 2v_2y + 2w_2z + d_2 = 0$$

cut each other orthogonally if

- (a) $2u_1u_2 + 2v_1v_2 + 2w_1w_2 = d_1 + d_2$ ☐
 (b) $u_1u_2 + v_1v_2 + w_1w_2 = 0$ ☐
 (c) $\frac{u_1}{u_2} = \frac{v_1}{v_2} = \frac{w_1}{w_2} = \frac{d_1}{d_2}$ ☐
 (d) $2(u_1 - u_2) + 2(v_1 - v_2) + 2(w_1 - w_2) = (d_1 - d_2)$ ☐

110. If d is the distance between the centres of two spheres of radii r_1 and r_2 , then the angle between them is given by

- (a) $\cos^{-1}(r_1^2 + r_2^2 - d^2)$ ☐
 (b) $\cos^{-1}\left(\frac{r_1^2 + r_2^2 - d^2}{2r_1r_2}\right)$ ☐
 (c) $\cos^{-1}\left(\frac{r_1^2 + r_2^2 - d^2}{r_1r_2}\right)$ ☐
 (d) $\cos^{-1}\sqrt{\frac{r_1^2 + r_2^2 - d^2}{2r_1r_2}}$ ☐

111. If $f(x, y, z) = 0$ be a homogeneous equation in x, y, z , then which of the following is incorrect?

- (a) $f(rx, ry, rz) = 0 \forall r$ ☐
 (b) $f(-x, -y, -z) = 0$ ☐
 (c) $f(x, y, -z) = 0$ ☐
 (d) All of the above ☐

112. Which of the following represents a quadric cone?

- (a) A homogeneous equation of second degree ☐
 (b) Any equation of second degree ☐
 (c) A homogeneous equation of third degree ☐
 (d) A homogeneous equation of fourth degree ☐

113. The general equation of second degree in x, y, z ,

$$ax^2 + by^2 + cz^2 + 2fyz + 2gzx + 2hxy + 2ux + 2vy + 2wz + d = 0$$

represents a cone with its vertex at the origin if

- (a) $d = 0$ only ☐
 (b) $d = 0, u = 0$ only ☐
 (c) $d = 0, u = 0, v = 0$ only ☐
 (d) $u = v = w = d = 0$ ☐

114. The equation of the cone with vertex at origin passing through the curve of intersection of the plane $lx + my + nz = p$ and the surface $ax^2 + by^2 + cz^2 = 1$ is given by

- (a) $ax^2 + by^2 + cz^2 - 1 + \lambda(lx + my + nz - p) = 0$ ☐
 where λ is any arbitrary constant ☐
 (b) $ax^2 + by^2 + cz^2 = (lx + my + nz)^2$ ☐
 (c) $ax^2 + by^2 + cz^2 = \left(\frac{lx + my + nz}{p}\right)^2$ ☐
 (d) $ax^2 + by^2 + cz^2 = \frac{lx + my + nz}{p}$ ☐

115. The plane $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$ meets the coordinate axes in A, B, C . Which of the following is the equation of the cone generated by the lines drawn from O meeting the circle ABC ?

- (a) $yz\left(\frac{b}{c} + \frac{c}{b}\right) + zx\left(\frac{c}{a} + \frac{a}{c}\right) + xy\left(\frac{a}{b} + \frac{b}{a}\right) = 0$ ☐

- (b) $ayz + bz x + cxy = 0$ ☐
 (c) $yz(b^2 + c^2) + zx(c^2 + a^2) + xy(a^2 + b^2) = 0$ ☐
 (d) None of the above ☐

116. The equation of the cone whose vertex is the origin and base is the curve $z=k$, $f(x, y)=0$, is given by

- (a) $f\left(\frac{x}{z}, \frac{y}{z}\right) = 0$ ☐
 (b) $f(xz, yz) = 0$ ☐
 (c) $f(kxz, ky z) = 0$ ☐
 (d) $f\left(\frac{kx}{z}, \frac{ky}{z}\right) = 0$ ☐

117. Which of the following is the equation of the cone passing through the three axes?

- (a) $ax^2 + by^2 + cz^2 + 2fyz + 2gzx + 2hxy = 0$ ☐
 (b) $fyz + gzx + hxy = 0$ ☐
 (c) $ax^2 + by^2 + cz^2 = 0$ ☐
 (d) None of the above ☐

118. How many arbitrary constants does the general equation of a quadric cone with a given vertex contain?

- (a) 4 ☐
 (b) 5 ☐
 (c) 6 ☐
 (d) 3 ☐

119. A cone can be determined so as to have any given five concurrent lines as generators. The maximum number of coplanar lines out of these is

- (a) 2 ☐
 (b) 3 ☐
 (c) 4 ☐
 (d) 5 ☐

120. The equation of the cone passing through the three coordinate axes and the lines

$$\frac{x}{1} = \frac{y}{-2} = \frac{z}{3}, \quad \frac{x}{3} = \frac{y}{-1} = \frac{z}{1}$$

is given by

- (a) $yz - 2zx + 3xy = 0$ ☐
 (b) $3yz - zx + xy = 0$ ☐
 (c) $3yz + 16zx + 15xy = 0$ ☐
 (d) None of the above ☐

121. The equation of the quadric cone passing through the three coordinate axes and the three mutually perpendicular straight lines is given by

- (a) $2yz + zx - xy = 0$ ☐
 (b) $16yz - 33zx - 25xy = 0$ ☐
 (c) $16yz - 33zx - 35xy = 0$ ☐
 (d) $8yz - 11zx + 5xy = 0$ ☐

122. The general equation of second degree

$$ax^2 + by^2 + cz^2 + 2fyz + 2gzx + 2hxy + 2ux + 2vy + 2wz + d = 0$$

represents a cone if

- (a) $\begin{vmatrix} a & h & g & 1 \\ h & b & f & 1 \\ g & f & c & 1 \\ 1 & 1 & 1 & 1 \end{vmatrix} = 0$ ☐
 (b) $\begin{vmatrix} a & h & g & u \\ h & b & f & v \\ g & f & c & w \\ u & v & w & 1 \end{vmatrix} = 0$ ☐
 (c) $\begin{vmatrix} a & h & g \\ h & b & f \\ g & f & c \end{vmatrix} = 0$ ☐
 (d) $\begin{vmatrix} a & h & g & u \\ h & b & f & v \\ g & f & c & w \\ u & v & w & d \end{vmatrix} = 0$ ☐

123. If $F(x, y, z, t) = 0$ be a homogenous equation of second degree representing a cone then the coordinates of its vertex satisfy

- (a) $F_x = 0, F_y = 0, F_z = 0$ but $F_t \neq 0$ ☐
 (b) $F_x = 0, F_y = 0, F_z = 0, F_t = 0$ ☐
 (c) $F_x = 0, F_y = 0, F_z = 0, F_t$ may or may not vanish ☐
 (d) $F_t = 0$ but F_x, F_y, F_z are not zero ☐

124. The plane $ax + by + cz = 0$ cuts the cone $yz + zx + xy = 0$ in perpendicular lines if

- (a) $a + b + c = 0$ ☐

(b) $ab+bc+ca=0$ ☐

(c) $\frac{1}{a} + \frac{1}{b} = \frac{1}{c}$ ☐

(d) $\frac{1}{a} - \frac{1}{b} - \frac{1}{c} = 0$ ☐

125. The cone

$$ax^2+by^2+cz^2+2fyz+2gzx+2hxy=0$$

has three mutually perpendicular generators if

(a) $a+b+c=0$ ☐

(b) $f+g+h=0$ ☐

(c) $ab+bc+ca=0$ ☐

(d) $fg+gh+hf \neq 0$ ☐

126. If $a+b+c=0$, then the cone

$$ax^2+by^2+cz^2+2fyz+2gzx+2hxy=0$$

has how many sets of mutually perpendicular generators?

(a) Only one ☐

(b) Two ☐

(c) More than two but a finite number of sets ☐

(d) An infinite number of sets ☐

127. The cone

$$ax^2+by^2+cz^2+2fyz+2gzx+2hxy+2ux+2vy+2wz+d=0$$

has sets of three mutually perpendicular generators if

(a) $f+g+h=0$ ☐

(b) $au+bv+cw+d=0$ ☐

(c) $a+b+c=0$ ☐

(d) $af+bg+ch=0$ ☐

128. What is the condition that the plane $lx+my+nz=0$ should touch the cone

$$ax^2+by^2+cz^2+2fyz+2gzx+2hxy=0?$$

(a)
$$\begin{vmatrix} a & h & g & l \\ h & b & f & m \\ g & f & c & n \\ l & m & n & 1 \end{vmatrix} = 0$$
 ☐

(b)
$$\begin{vmatrix} l & h & g \\ m & b & f \\ n & f & c \end{vmatrix} = 0$$
 ☐

(c)
$$\begin{vmatrix} a & h & g & l \\ h & b & f & m \\ g & f & c & n \\ l & m & n & 0 \end{vmatrix} = 0$$
 ☐

(d) None of the above ☐

129. The condition that the cone

$$ax^2+by^2+cz^2+2fyz+2gzx+2hxy=0$$

possesses three mutually perpendicular tangent planes is

(a) $a+b+c=0$ ☐

(b) $ab+bc+ca=0$ ☐

(c) $ab+bc+ca=f^2+g^2+h^2$ ☐

(d) $af+bg+ch=0$ ☐

130. The general equation of a cone touching the three coordinate planes is

(a) $\sqrt{fx} \pm \sqrt{gy} \pm \sqrt{hz} = 0$ ☐

(b) $fx \pm gy \pm hz = 0$ ☐

(c) $fx \pm gy \pm hz = 1$ ☐

(d) $\sqrt{fx} \pm \sqrt{gy} \pm \sqrt{hz} = 1$ ☐

131. Two cones with common vertex intersect in general in how many common generators?

(a) Two ☐

(b) Three ☐

(c) Four ☐

(d) Any number ☐

132. The equation of a right circular cone with vertex $(0, 0, 0)$, axis along z-axis and semi-vertical angle α is

(a) $x^2+y^2=z^2 \tan^2 \theta$ ☐

(b) $x^2+y^2=z^2 \sin^2 \theta$ ☐

(c) $z^2=(x^2+y^2) \sin^2 \theta$ ☐

(d) None of the above ☐

133. The semi-vertical angle of a right circular cone having sets of three mutually perpendicular generators is given by

(a) $\tan^{-1} \left(\frac{1}{\sqrt{2}} \right)$ ☐

(b) $\tan^{-1} (\sqrt{2})$ ☐

(c) $\frac{\pi}{4}$ ☐

(d) $\frac{\pi}{2}$ ☐

134. A semi-vertical angle of a right circular cone having sets of three mutually perpendicular tangent planes is

(a) $\tan^{-1}\left(\frac{1}{\sqrt{2}}\right)$ ☐

(b) $\tan^{-1}(\sqrt{2})$ ☐

(c) $\frac{\pi}{4}$ ☐

(d) $\frac{\pi}{2}$ ☐

135. The equation of the circular cones containing the three coordinate axis as generators is given by

(a) $yz \pm zx \pm xy = 0$ ☐

(b) $x^2 \pm y^2 \pm z^2 = 0$ ☐

(c) $x^2 + y^2 = z^2$ ☐

(d) None of the above ☐

136. The equation

$$ax^2 + by^2 + cz^2 + 2ux + 2vy + 2wz + d = 0$$

represents a cone if

(a) $u^2 + v^2 + w^2 = abcd$ ☐

(b) $\frac{u^2}{a} + \frac{v^2}{b} + \frac{w^2}{c} = d$ ☐

(c) $(u-a)^2 + (v-b)^2 + (z-c)^2 = 0$ ☐

(d) $u + v + w = a + b + c = 0$ ☐

137. The lines in which the plane

$$ux + vy + wz = 0$$

cuts the cone

$$f(x, y, z) = ax^2 + by^2 + cz^2 + 2fyz + 2gzx + 2hxy = 0$$

are at right angles if

(a) $(a+b+c)(u^2 + v^2 + w^2) = fvw + gwu + huv$ ☐

(b) $(a+b+c)(u^2 + v^2 + w^2) = au^2 + bv^2 + cw^2$ ☐

(c) $(a+b+c)(u^2 + v^2 + w^2) = f(u, v, w)$ ☐

(d) $\left(\frac{1}{a} + \frac{1}{b} + \frac{1}{c}\right)\left(\frac{1}{u} + \frac{1}{v} + \frac{1}{w}\right) = fvw + gwu + huv$ ☐

ANSWERS

- | | | | | | |
|-------|-------|-------|--------|--------|--------|
| 1. c | 2. b | 3. a | 70. a | 71. c | 72. a |
| 4. c | 5. b | 6. d | 73. d | 74. c | 75. d |
| 7. b | 8. c | 9. c | 76. b | 77. b | 78. c |
| 10. b | 11. b | 12. c | 79. d | 80. d | 81. a |
| 13. b | 14. a | 15. b | 82. c | 83. c | 84. b |
| 16. b | 17. a | 18. b | 85. c | 86. a | 87. d |
| 19. d | 20. d | 21. a | 88. c | 89. d | 90. b |
| 22. b | 23. d | 24. b | 91. b | 92. b | 93. c |
| 25. b | 26. c | 27. d | 94. a | 95. a | 96. c |
| 28. a | 29. d | 30. c | 97. b | 98. c | 99. b |
| 31. d | 32. a | 33. c | 100. c | 101. d | 102. a |
| 34. c | 35. a | 36. a | 103. c | 104. d | 105. b |
| 37. d | 38. b | 39. a | 106. c | 107. d | 108. d |
| 40. c | 41. b | 42. a | 109. a | 110. b | 111. c |
| 43. b | 44. c | 45. a | 112. a | 113. d | 114. c |
| 46. d | 47. b | 48. a | 115. a | 116. d | 117. b |
| 49. c | 50. c | 51. d | 118. b | 119. a | 120. c |
| 52. b | 53. c | 44. a | 121. b | 122. d | 123. b |
| 55. b | 56. c | 57. d | 124. b | 125. a | 126. d |
| 58. d | 59. b | 60. b | 127. c | 128. c | 129. c |
| 61. d | 62. d | 63. c | 130. a | 131. c | 132. a |
| 64. a | 65. c | 66. a | 133. b | 134. a | 135. a |
| 67. c | 68. b | 69. b | 136. b | 137. c | |

Vector Algebra

1. Which of the following gives correct definition of a directed line segment (D.L.S.) ?

- (a) A D.L.S. is a portion of a straight line with its initial point at the origin ☐
- (b) A D.L.S. is any portion of a straight line ☐
- (c) A D.L.S. is a portion of a straight line with one end at the origin and the other end arbitrary ☐
- (d) A D.L.S. is a portion of a straight line with two end points distinguished as an initial point and a terminal point ☐

2. Two forces $\vec{a}$ and $\vec{b}$ acting at a common point are equivalent to a single force $\vec{r}$, called the resultant force. Then $\vec{r}$ is equal to

- (a) $\lambda \vec{a} + \mu \vec{b}$ where λ and μ are any scalars ☐
- (b) $\vec{a} + \vec{b}$ ☐
- (c) $\vec{a} - \vec{b}$ ☐
- (d) $\vec{a} \cdot \vec{b}$ ☐

3. Which one of the following is wrong ? Vector are quantities which have both magnitude and direction and also have the following properties :

- (a) They are combined according to triangle law or parallelogram law ☐
- (b) Multiplication of a quantity by any non-zero real number means that its magnitude is multiplied by that number but the direction remains unchanged ☐

(c) Multiplication by a real number zero means that the magnitude of a quantity becomes zero and its direction is arbitrary ☐

(d) None of the above ☐

4. Which one of the following is not an example of a vector ?

- (a) Displacement ☐
- (b) Momentum ☐
- (c) Mass ☐
- (d) Angular velocity ☐

5. Which one of the following is an example of a vector ?

- (a) Force ☐
- (b) Time ☐
- (c) Temperature ☐
- (d) Energy ☐

6. Which one of the following is not an example of a scalar quantity ?

- (a) Electric intensity ☐
- (b) Work ☐
- (c) Potential ☐
- (d) Power ☐

7. Which of the following quantities are vectors ?

- (1) Linear velocity
(2) Magnetic intensity
(3) Volume
(4) Power
(5) Electrical resistance

- (a) (1) and (5) only ☐
- (b) (1), (2) and (5) only ☐
- (c) (1), (3) and (4) only ☐
- (d) (1) and (2) only ☐

8. What is needed to specify a scalar ?
 (a) A unit for its measurement ☐
 (b) A real number ☐
 (c) Both a unit for its measurement and a real number ☐
 (d) A unit for its measurement and a rational number ☐
9. Which of the following is absurd ? If $\vec{a}, \vec{b}, \vec{c}$ are any three vectors and x, y are any real numbers, then
 (a) $x \cdot (\vec{a} + \vec{b}) = x \cdot \vec{a} + y \cdot \vec{b}$ ☐
 (b) $x \cdot (\vec{a} \cdot \vec{b}) = (x \cdot \vec{a}) \cdot \vec{b}$ ☐
 (c) $(x \cdot y) \cdot \vec{a} = x \cdot (y \cdot \vec{a})$ ☐
 (d) $(x+y) \cdot \vec{a} = x \cdot \vec{a} + y \cdot \vec{a}$ ☐
10. Which is incorrect ?
 (a) Any representative of the class of vectors having magnitude and direction but no fixed position, is called a free vector ☐
 (b) Force is an example of a free vector ☐
 (c) A free vector is said to be a localized vector if its initial point is specified ☐
 (d) The set of all vectors in the plane can be identified with the set of ordered pairs of real numbers i.e. the points in the plane ☐
11. Two vectors are said to be equal if they have the
 (a) Same length ☐
 (b) Same length and same direction ☐
 (c) Same length, same direction and same support ☐
 (d) Same length and same support ☐
12. The vectors having same initial point are called
 (a) Collinear vectors ☐
 (b) Coplanar vectors ☐
 (c) Co-initial vectors ☐
 (d) Free vectors ☐
13. A constant vector $\vec{a}$ has
 (a) Its direction fixed ☐
 (b) Its magnitude and direction both fixed ☐
 (c) Its magnitude fixed ☐
 (d) Either a fixed magnitude or a fixed direction ☐
14. The magnitude of a vector is
 (a) Unique ☐
 (b) Not unique ☐
 (c) A unique positive integer ☐
 (d) Not always unique but can have only a finite number of values ☐
15. Which one of the following statements is wrong ?
 (a) Vector addition is associative and commutative both ☐
 (b) For any vectors $\vec{a}, \vec{b}, \vec{c}$,
 $\vec{a} \cdot (\vec{b} + \vec{c}) = \vec{a} \cdot \vec{b} + \vec{a} \cdot \vec{c}$
 i.e. vector multiplication is distributive over addition ☐
 (c) For any vector $\vec{a}$, $\exists$ a vector $\vec{o}$ such that $\vec{a} + \vec{o} = \vec{a}$ ☐
 (d) For any vector $\vec{a}$, $\exists$ a vector $(-\vec{a})$ such that $\vec{a} + (-\vec{a}) = \vec{0}$ ☐
16. A vector whose magnitude is one, is called
 (a) Zero vector ☐
 (b) Constant vector ☐
 (c) Unit vector ☐
 (d) None of the above ☐
17. $|\vec{a} + \vec{b}| = |\vec{a}| + |\vec{b}|$ where $\vec{a}$ and $\vec{b}$ are any vectors. This equality
 (a) Always holds ☐
 (b) Never holds ☐
 (c) Holds only if $\vec{a} = k\vec{b}$, $k \geq 0$ or $\vec{a} = \vec{b} = \vec{0}$ ☐
 (d) Holds only if $\vec{a} = \vec{b} = \vec{0}$ ☐

18. If $\vec{a}$ is a non-zero vector such that $|\vec{k a}| = 1$, then k is a scalar equal to

(a) 1 ☐

(b) $\frac{1}{|\vec{a}|}$ ☐

(c) $-\frac{1}{|\vec{a}|}$ ☐

(d) $\pm \frac{1}{|\vec{a}|}$ ☐

19. $|\vec{a}| = |\vec{b}|$

(a) If and only if $\vec{a} = \vec{b}$ ☐

(b) Implies that $\vec{a} = \vec{b}$ but the converse is not true ☐

(c) Does not imply that $\vec{a} = \vec{b}$ but the converse is true ☐

(d) Neither implies that $\vec{a} = \vec{b}$ nor the converse is true ☐

20. Which of the following inequalities always holds? For any vectors $\vec{a}$ and $\vec{b}$,

(a) $|\vec{a}| + |\vec{b}| \leq |\vec{a+b}|$ ☐

(b) $|\vec{a}| - |\vec{b}| \leq |\vec{a-b}|$ ☐

(c) $|\vec{b-a}| \leq |\vec{b}| - |\vec{a}|$ ☐

(d) None of the above ☐

21. If $\vec{a}, \vec{b}, \vec{c}$ and $\vec{d}$ be the position vectors of four distinct points P, Q, R, S forming a parallelogram, then

(a) $\vec{a} + \vec{b} = \vec{c} + \vec{d}$ ☐

(b) $\vec{a} + \vec{c} = \vec{b} + \vec{d}$ ☐

(c) $\vec{a} + \vec{d} = \vec{b} + \vec{c}$ ☐

(d) $\vec{d} - \vec{a} = \vec{b} - \vec{c}$ ☐

22. Let $\vec{a}, \vec{b}$ and $\vec{c}$ be the position vectors of three points A, B and C respectively,

such that $\alpha \vec{a} + \beta \vec{b} + \gamma \vec{c} = \vec{0}$ and $\alpha + \beta + \gamma = 0$, where α, β, γ are any scalars (not all zero). Then A, B, C are

(a) The vertices of a right-angled triangle ☐

(b) The vertices of an isosceles triangle ☐

(c) The vertices of an equilateral triangle ☐

(d) None of the above ☐

23. Which of the following statements is correct?

Two vectors $\vec{a}$ and $\vec{b}$ are linearly dependent if

(a) $\exists$ scalars x and y such that

$x \vec{a} + y \vec{b} = \vec{0} \Rightarrow x=0, y=0$ ☐

(b) None of $\vec{a}$ and $\vec{b}$ can be expressed as a scalar multiple of the other ☐

(c) They are collinear vectors ☐

(d) They are non-collinear vectors ☐

24. If $\vec{a}$ and $\vec{b}$ be any two non-zero non-collinear vectors and x, y are any scalars, then

(a) $x \vec{a} + y \vec{b}$ is always equal to zero ☐

(b) $x \vec{a} + y \vec{b}$ can never be equal to zero ☐

(c) $x \vec{a} + y \vec{b} = \vec{0}$ if either $x=0$ or $y=0$ ☐

(d) $x \vec{a} + y \vec{b} = \vec{0}$ only when $x=0$ and $y=0$ ☐

25. If $\vec{a} + 5\vec{b} = \vec{c}$, $\vec{a} - 7\vec{b} = 2\vec{c}$, which of the following statements is correct?

(a) $\vec{a}$ and $\vec{c}$ have the same direction but $\vec{b}$ and $\vec{c}$ have opposite ☐

(b) $\vec{a}$ and $\vec{b}$ have opposite direction so also $\vec{a}$ and $\vec{c}$ ☐

(c) $\vec{b}$ and $\vec{c}$ have same direction but $\vec{a}$ and $\vec{b}$ opposite ☐

(d) $\vec{a}$ and $\vec{c}$ have opposite direction so also $\vec{b}$ and $\vec{c}$ ☐

26. Let $\vec{a}$ and $\vec{b}$ be any two non-zero, non-collinear, coplanar vectors and $\vec{r}$ be any vector lying in the plane of $\vec{a}$ and $\vec{b}$, then

- (a) A unique pair (x, y) of scalars exists such that $\vec{r} = x\vec{a} + y\vec{b}$ ☐
- (b) A unique pair (x, y) of scalars will exist such that $\vec{r} = x\vec{a} + y\vec{b}$ only if $\vec{r} \parallel \vec{a}$ or $\vec{r} \parallel \vec{b}$ ☐
- (c) No pair (x, y) of scalars exists satisfying $\vec{r} = x\vec{a} + y\vec{b}$ ☐
- (d) $\vec{r} = x\vec{a} + y\vec{b}$ but we cannot declare whether the pair (x, y) of scalars is unique or not ☐

27. If $\vec{a}, \vec{b}, \vec{c}$ are any three non-zero, non-coplanar vectors, then they are

- (a) Linearly independent ☐
- (b) Linearly dependent in some cases but not always ☐
- (c) Linearly independent only if either $\vec{a} \parallel \vec{b}$ or $\vec{b} \parallel \vec{c}$ or $\vec{a} \parallel \vec{c}$ ☐
- (d) Linearly independent only if either $\vec{a} \perp \vec{b}$ or $\vec{a} \perp \vec{c}$ or $\vec{b} \perp \vec{c}$ ☐

28. Which of the following is not a set of linearly dependent vectors?

- (a) Any two collinear vectors ☐
- (b) Any two non-collinear vectors ☐
- (c) Any three coplanar vectors ☐
- (d) Any set of four vectors ☐

A triad of non-coplanar vectors $\vec{a}, \vec{b}, \vec{c}$ is said to be a base if every vector $\vec{r}$ can be expressed as a linear combination of $\vec{a}, \vec{b}$ and $\vec{c}$. i.e. $\vec{r} = \alpha\vec{a} + \beta\vec{b} + \gamma\vec{c}$, where α, β, γ are any scalars, called the coordinates of the vector $\vec{r}$.

29. If x, y, z are the coordinates of $\vec{r}$ w.r.t. the base $\{\vec{a}, \vec{b}, \vec{c}\}$ and x', y', z' are the coordinates of $\vec{r}$ w.r.t. the base $\{\vec{a}', \vec{b}', \vec{c}'\}$, then

- (a) x, y, z can be expressed in terms of the coordinates x', y', z' and x', y', z' can be expressed in terms of the coordinates x, y, z ☐
- (b) x, y, z can be expressed in terms of x', y', z' but not conversely ☐
- (c) x', y', z' can be expressed in terms of x, y, z but not conversely ☐
- (d) Neither x, y, z can be expressed in terms of x', y', z' nor x', y', z' in terms of x, y, z ☐

30. If x, y, z are the coordinates of $\vec{r}$ w.r.t. the bases $\{\vec{a}, \vec{b}, \vec{c}\}$, to find the coordinates of $\vec{r}$ w.r.t. the bases $\{\vec{a} - \vec{b} + \vec{c}, \vec{b} + \vec{c} - \vec{a}, 2\vec{a} - 3\vec{b} + 4\vec{c}\}$

- (a) $\frac{7}{2}x + 3y + \frac{1}{2}z, \frac{1}{2}x + y + \frac{1}{2}z, -x - y$ ☐
- (b) $\frac{1}{2}x + y + \frac{1}{2}z, -x - y, \frac{7}{2}x + 3y + \frac{1}{2}z$ ☐
- (c) $-x - y, \frac{7}{2}x + 3y + \frac{1}{2}z, \frac{1}{2}x + y + \frac{1}{2}z$ ☐
- (d) $\frac{7}{2}x + 3y + \frac{1}{2}z, \frac{1}{2}x + y + \frac{1}{2}z, x - y$ ☐

31. If $\vec{a}$ and $\vec{b}$ are two linearly independent vectors, then the vectors $m\vec{a} + \vec{b}$ and $\vec{a} + m\vec{b}$ are

- (a) Always linearly independent ☐
- (b) Linearly independent if $m \neq \pm 1$ ☐
- (c) Linearly independent if $m \neq 0$ ☐
- (d) Linearly dependent if $m = 0$ ☐

32. Let A, B be two points with position vectors $\vec{a} - 3\vec{b}$ and $6\vec{b} - 2\vec{a}$ respectively. A point P on the line AB divides it in the ratio $1 : 2$, then the position vector of the point P is

- (a) $\frac{-\vec{a} + 3\vec{b}}{3}$ ☐
- (b) $\frac{-3\vec{a} + 9\vec{b}}{3}$ ☐

(c) $\vec{0}$

(d) None of the above

33. Let $\vec{a}$ be the position vector of the point A and origin divides the line joining AB in the ratio $1 : 2$, then the position vector of B is given by

(a) $2\vec{a}$

(b) $-2\vec{a}$

(c) $\frac{1}{2}\vec{a}$

(d) $-\frac{1}{2}\vec{a}$

34. If a vector $\vec{a}$ points north-east and a vector $\vec{b}$ points north-west such that

$$|\vec{a}| = |\vec{b}| = 5,$$

then the magnitude and direction of the vector $\vec{a} - \vec{b}$ must be

(a) $\sqrt{50}$ towards east

(b) $5\sqrt{2}$ towards west

(c) 10 towards east

(d) 10 towards west

35. If $\vec{a}$ and $\vec{b}$ are unit vectors such that $|\vec{a} + \vec{b}| = 1$. Find the magnitude of $\vec{a} - \vec{b}$.

(a) 3

(b) 0

(c) $\sqrt{3}$

(d) None of the above

36. $|\vec{a} + \vec{b}| = |\vec{a} - \vec{b}|$. This means that

(a) $\vec{b} = \vec{0}$

(b) $\vec{a} = \vec{0}$

(c) Parallelogram whose sides are $\vec{a}$ and $\vec{b}$, is a rectangle

(d) $\vec{a} = \vec{b}$

37. The unit vector parallel to the sum of vectors $\vec{a} = 2\vec{i} + 4\vec{j} - 5\vec{k}$ and

$$\vec{b} = \vec{i} + 2\vec{j} + 3\vec{k}$$

is given by

(a) $3\vec{i} + 6\vec{j} - 2\vec{k}$

(b) $\frac{3\vec{i} + 6\vec{j} - 2\vec{k}}{7}$

(c) $\frac{2\vec{i} + 4\vec{j} - 5\vec{k}}{\sqrt{14}}$

(d) $\frac{\vec{i} + 2\vec{j} + 3\vec{k}}{\sqrt{45}}$

38. If $\vec{a} = \vec{i} + \vec{j} + \vec{k}$, $\vec{b} = 2\vec{i} + 3\vec{j}$, $\vec{c} = 3\vec{i} + 5\vec{j} - 2\vec{k}$, $\vec{d} = -\vec{j} + \vec{k}$

then $|\vec{b} - \vec{a}| : |\vec{d} - \vec{c}|$ is

(a) 1 : 3

(b) 1 : 9

(c) 1 : -3

(d) 3 : -1

39. The components of a vector PQ , where $P(2, 3)$ is its initial point and $Q(4, 6)$ is its terminal point, along x -axis and y -axis are given by

(a) 6 and 9

(b) 2 and 3

(c) 0 and 1

(d) 1 and 0

40. The direction cosines of a vector PQ , whose initial point is $P(-1, -3)$ and the components of PQ along x and y directions are given by 5 and 0 respectively, are given by

(a) 5 and 0

(b) 1 and 0

(c) 4 and -3

(d) 6 and 3

41. The components of the vector PQ along x and y directions whose magnitude is 3 and which makes an angle of 210° with x -axis, are

- (a) $\frac{3\sqrt{3}}{2}, \frac{3}{2}$
 (b) $\frac{3\sqrt{3}}{2}, -\frac{3}{2}$
 (c) $-\frac{3\sqrt{3}}{2}, \frac{3}{2}$
 (d) $-\frac{3\sqrt{3}}{2}, -2\frac{3}{2}$

42. Product of vectors is analogous to the product of

- (a) Real numbers
 (b) Irrational numbers
 (c) Matrices
 (d) Complex numbers

43. Which is the incorrect statement:—

The scalar product of $\vec{a}$ and $\vec{b}$ is same as the product of

- (a) $\vec{a}$ and projection of $\vec{b}$ on $\vec{a}$
 (b) $\vec{b}$ and projection of $\vec{a}$ on $\vec{b}$
 (c) Projection of $\vec{b}$ on $\vec{a}$ and the projection of $\vec{a}$ on $\vec{b}$
 (d) $|\vec{a}| \cdot |\vec{b}| \cos \theta$ where θ is the angle between $\vec{a}$ and $\vec{b}$

44. If the vectors $3\vec{i} + 4\vec{j}$ and $-5\vec{i} + \lambda\vec{j}$ are perpendicular, then λ is equal to

- (a) $\frac{15}{4}$
 (b) $-\frac{20}{3}$
 (c) $-\frac{15}{4}$
 (d) $\frac{20}{3}$

45. The work done by the force

$$\vec{F} = 4\vec{i} + 2\vec{j} + 3\vec{k}$$

acting on a particle where the particle is dis-

placed from the point $A(1, 2, 0)$ to the point $B(2, -1, 3)$ is given by — units

- (a) 7
 (b) $\sqrt{551}$
 (c) $\sqrt{26}$
 (d) $\sqrt{34}$

46. Which one of the following is incorrect?

Two vectors $\vec{a}$ and $\vec{b}$ are perpendicular if

- (a) $\vec{a} \cdot \vec{b} = 0$
 (b) $|\vec{a} + \vec{b}| = |\vec{a} - \vec{b}|$
 (c) $(\vec{a} + \vec{b})^2 = (\vec{a} - \vec{b})^2$
 (d) Exactly one of the above statements is correct

47. If $\vec{a} + \vec{b} + \vec{c} = 0$ and $|\vec{a}| = 3, |\vec{b}| = 5, |\vec{c}| = 7$,

then the angle between $\vec{a}$ and $\vec{b}$ is

- (a) $\cos^{-1}\left(\frac{15}{2}\right)$
 (b) $\frac{\pi}{3}$
 (c) $\frac{\pi}{2}$
 (d) $\cos^{-1}\left(\frac{225}{2}\right)$

48. If $(\vec{a} - \vec{b}) \cdot (\vec{a} + \vec{b}) = 0$, then

- (a) $\vec{a} \perp \vec{b}$
 (b) $\vec{a} \parallel \vec{b}$
 (c) $|\vec{a}| = |\vec{b}|$
 (d) $\vec{a} = \vec{b}$

49. If $\vec{a} \cdot \vec{b} = \vec{a} \cdot \vec{c}$, then which of the following is correct?

- (a) $\vec{a} = 0$
 (b) $\vec{b} = \vec{c}$

- (c) $\vec{a} \perp (\vec{b} - \vec{c})$ ☐
 (d) Either of the above ☐

50. If $\vec{a}$ and $\vec{b}$ are any two vectors and are inclined at an angle θ with each other, then

vector product of $\vec{a}$ and $\vec{b}$ to be denoted by $\vec{a} \times \vec{b}$ is given by $|\vec{a}| |\vec{b}| \sin \theta \hat{n}$ where $\hat{n}$ is

- (a) Any vector whose magnitude is unity ☐
 (b) Unit vector perpendicular to both

$\vec{a}$ and $\vec{b}$ ☐

- (c) Unit vector parallel to both $\vec{a}$ and $\vec{b}$ ☐

- (d) Unit vector perpendicular to $\vec{a}$ and parallel to $\vec{b}$ ☐

51. Which of the following statements is correct?

- (a) Vector product is associative ☐
 (b) Vector product is commutative ☐
 (c) Vector product is associative w.r.t. a scalar ☐
 (d) Exactly one of the above statements is incorrect ☐

52. Which is not a correct statement?

Two vectors $\vec{a}$ and $\vec{b}$ are perpendicular if

- (a) $|\vec{a} + \vec{b}|^2 = |\vec{a}|^2 + |\vec{b}|^2$ ☐

- (b) $\vec{a} \times \vec{b} = |\vec{a}| |\vec{b}| \hat{n}$, where $\hat{n}$ is a unit vector perpendicular to both $\vec{a}$ and $\vec{b}$ ☐

- (c) $\vec{a} \times \vec{b} = 0$ ☐

- (d) Exactly one of the above statements is wrong ☐

53. Which is a correct statement?

$\vec{a} \times \vec{b}$ is a vector

- (a) Whose magnitude is the area of a parallelogram with adjacent sides represented by $\vec{a}$ and $\vec{b}$ ☐

- (b) Whose magnitude is the area of a rectangle with adjacent sides represented by $\vec{a}$ and $\vec{b}$ ☐

- (c) Both of the above ☐

- (d) None of the above ☐

54. If $\vec{a} = a_1 \vec{i} + a_2 \vec{j} + a_3 \vec{k}$ and $\vec{b} = b_1 \vec{i} + b_2 \vec{j} + b_3 \vec{k}$

are any two vectors, then $\vec{a} \times \vec{b}$ is equal to

- (a) $\begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \end{vmatrix}$ ☐

- (b) $\begin{vmatrix} \vec{i} & 0 & 0 \\ a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \end{vmatrix}$ ☐

- (c) $\begin{vmatrix} 0 & \vec{j} & 0 \\ a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \end{vmatrix}$ ☐

- (d) $\begin{vmatrix} 0 & 0 & \vec{k} \\ a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \end{vmatrix}$ ☐

55. $|\vec{a} \times \vec{b}|$ is equal to

- (a) $a^2 b^2 - (\vec{a} \cdot \vec{b})^2$ ☐

- (b) $\sqrt{a^2 b^2 - (\vec{a} \cdot \vec{b})^2}$ ☐

- (c) $a^2 b^2 - (\vec{a} \cdot \vec{b})^2$ ☐

- (d) $ab - \vec{a} \cdot \vec{b}$ ☐

56. The area of the parallelogram with sides formed by the vectors $3\vec{i} + 2\vec{j} + \vec{k}$ and $3\vec{i} + \vec{k}$ is given by—units.

(a) $2\sqrt{10}$ ☐

(b) $\sqrt{10}$ ☐

(c) $\sqrt{5}$ ☐

(d) $2\sqrt{5}$ ☐

57. Let $\vec{a}, \vec{b}, \vec{c}$ be the position vectors of A, B, C respectively. Then the area of triangle ABC is given by

(a) $\vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a}$ ☐

(b) $\frac{1}{2}(\vec{a} \times \vec{b}) \cdot \vec{c}$ ☐

(c) $\frac{1}{2}(\vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a})$ ☐

(d) None of the above ☐

58. If $\vec{a} \times \vec{b} = \vec{b} \times \vec{c} \neq 0$, then for any scalar m ,

(a) $\vec{a} + \vec{c} = m\vec{b}$ ☐

(b) $\vec{a} + \vec{b} = m\vec{c}$ ☐

(c) $\vec{b} + \vec{c} = m\vec{a}$ ☐

(d) $\vec{a} - \vec{b} = m(\vec{c} - \vec{b})$ ☐

59. The unit vector perpendicular to the vectors $\vec{i} + \vec{j} + \vec{k}$ and $\vec{i} - 2\vec{k}$ is given by

(a) $-2\vec{i} + 3\vec{j} - \vec{k}$ ☐

(b) $-\frac{\vec{i}}{7} + \frac{3\vec{j}}{14} - \frac{\vec{k}}{14}$ ☐

(c) $\frac{1}{\sqrt{14}}(-\vec{i} + 3\vec{j} - \vec{k})$ ☐

(d) None of the above ☐

60. If $(\vec{a} - \vec{b}) \times (\vec{a} + \vec{b}) = 2\vec{a} \times \vec{b}$, then

(a) The area of the parallelogram whose sides are formed by the vectors $2\vec{a}$

and $\vec{b}$ is equal to the area of the parallelogram whose sides are formed by its diagonals ☐

(b) The area of the parallelogram whose sides are formed by the vectors $\vec{a}$

and $2\vec{b}$ is equal to the area of the parallelogram whose sides are formed by its diagonals ☐

(c) The area of the parallelogram whose sides are formed by the vectors $\vec{a}$

and $\vec{b}$ respectively is equal to half the area of parallelogram whose sides are formed by its diagonals ☐

(d) All of above statements are true ☐

61. If $\vec{a} + \vec{b} + \vec{c} = 0$, then $\vec{a} \times \vec{b} = \vec{b} \times \vec{c} = \vec{c} \times \vec{a}$.

This means that

(a) The vectors $\vec{a}, \vec{b}, \vec{c}$ are collinear ☐

(b) The vectors $\vec{a}, \vec{b}, \vec{c}$ are coplanar ☐

(c) The vectors $\vec{a}, \vec{b}, \vec{c}$ are non-collinear ☐

(d) At least two of the vectors must be non-zero ☐

62. Which of the following statements is correct?

If $\vec{a} \times \vec{b} = \vec{a} \times \vec{c}$, then

(a) $\vec{a} = 0$ necessarily ☐

(b) $\vec{b} = \vec{c}$ necessarily ☐

(c) It does not mean that $\vec{b} = \vec{c}$ always ☐

(d) At least two of the above statements are correct ☐

63. If $\vec{a} \cdot \vec{b} = \vec{a} \cdot \vec{c}$ and $\vec{a} \times \vec{b} = \vec{a} \times \vec{c}$, then

(a) It is necessary that $\vec{a} = 0$ ☐

(b) It is necessary that $\vec{a} \neq 0$ ☐

(c) It is necessary that $\vec{b} = \vec{c}$ ☐

(d) If $\vec{a} \neq 0$, it is necessary that $\vec{b}$ and $\vec{c}$ are equal ☐

64. Which one of the following is neither a scalar triple product nor a vector triple product of any three vectors $\vec{a}, \vec{b}, \vec{c}$?

- (a) $\vec{a} \cdot (\vec{b} \cdot \vec{c})$ ☐
 (b) $\vec{a} \cdot (\vec{b} \times \vec{c})$ ☐
 (c) $\vec{a} \times (\vec{b} \times \vec{c})$ ☐
 (d) $(\vec{a} \times \vec{b}) \cdot \vec{c}$ ☐

65. $\vec{a} \cdot (\vec{b} \times \vec{c})$ is equal to the

- (a) Area of the surface of all the faces of the parallelepiped formed by the

three vectors $\vec{a}, \vec{b}, \vec{c}$ ☐

- (b) Sum of the areas of two parallelograms whose sides are formed by the vectors $\vec{a}, \vec{b}$ and $\vec{b}, \vec{c}$ respectively ☐

- (c) Volume of the parallelepiped formed by the vectors $\vec{a}, \vec{b}, \vec{c}$ ☐

- (d) Area of the surface of all the faces of trapezium whose base is the triangle formed by the vectors $\vec{a}, \vec{b}, \vec{c}$ ☐

66. The volume of the parallelepiped whose sides are given by the vectors

$11\vec{i}, 2\vec{j}$, and $13\vec{k}$ respectively is given by

- (a) 0 ☐
 (b) 22 ☐
 (c) 26 ☐
 (d) 286 ☐

67. Which of the following does not vanish for any non-zero vectors

- $\vec{a}, \vec{b}, \vec{c}$?
- (a) $\vec{a} \cdot (\vec{b} \times \vec{a})$ ☐
 (b) $\vec{b} \cdot (\vec{a} \times \vec{c})$ ☐
 (c) $\vec{c} \cdot (\vec{a} \times \vec{c})$ ☐
 (d) $\vec{a} \cdot (\vec{c} \times \vec{a})$ ☐

68. If $\vec{a}, \vec{b}, \vec{c}$ are three non-zero and coplanar vectors such that $\vec{a} \cdot \vec{b} = 0$ and $\vec{b} \cdot \vec{c} = 0$, then

- (a) $\vec{a} \cdot \vec{c} = 0$ ☐
 (b) $\vec{a} \cdot \vec{c} \neq 0$ ☐
 (c) $\vec{a} \cdot \vec{c} \geq 0$ ☐
 (d) $\vec{a} \cdot \vec{c} \leq 0$ ☐

69. If $\vec{a}$ and $\vec{b}$ are unit vectors, then which of the following values of $\vec{a} \cdot \vec{b}$ is not possible?

- (a) $\vec{a} \cdot \vec{b} = \sqrt{3}$ ☐
 (b) $\vec{a} \cdot \vec{b} = \frac{\sqrt{3}}{2}$ ☐
 (c) $\vec{a} \cdot \vec{b} = \frac{1}{\sqrt{2}}$ ☐
 (d) $\vec{a} \cdot \vec{b} = -\frac{5}{6}$ ☐

70. If the vectors $\vec{i} - 2p\vec{j} + 3q\vec{k}$ and $\vec{i} + 2p\vec{j} - 3q\vec{k}$ are orthogonal, then locus of the point (p, q) is a/an

- (a) Circle ☐
 (b) Ellipse ☐
 (c) Hyperbola ☐
 (d) Straight line not passing through the origin ☐

71. The vectors $\vec{i} + 2p\vec{j} + 4q\vec{k}$ and $\vec{i} + 4p\vec{j} + 2q\vec{k}$ are

- (a) Orthogonal if $p=q$ ☐
 (b) „ if $p=-q$ ☐
 (c) „ if $p^2=q^2=-1$ ☐
 (d) Never orthogonal ☐

72. Let $p\vec{i} + 3\vec{j} + 4\vec{k}$ and $\sqrt{q}\vec{i} + 5\vec{k}$ be any two vectors where p, q are any non-negative scalars. If (p, q) is a pair of values for

which $l_1 = l_2$ where l_1, l_2 are the lengths of the given vectors then

- (a) The pair (p, q) is unique ☐
 (b) There can be infinitely many such pairs ☐
 (c) $\exists$ no such pair ☐
 (d) None of the above statements is correct ☐

73. In Q. 72, locus of (p, q) is given by a/an

- (a) Circle ☐
 (b) Ellipse ☐
 (c) Straight line passing through origin ☐
 (d) Parabola ☐

74. If $\vec{a}$ and $\vec{b}$ are any two vectors, then

- $|\vec{a} \cdot \vec{b}|$ is
 (a) Greater than or equal to ab ☐
 (b) Less than or equal to ab ☐
 (c) Less than $a+b$ ☐
 (d) Either greater than ab or less than ab ☐

75. Let $\vec{a}$ and $\vec{b}$ be any two vectors. Then the vector $\vec{a} \times (\vec{b} \times \vec{a})$ is perpendicular to

- (a) $\vec{a}$ ☐
 (b) $\vec{b}$ ☐
 (c) Both $\vec{a}$ and $\vec{b}$ ☐
 (d) Neither $\vec{a}$ nor $\vec{b}$ ☐

76. The vector $\vec{a} \times (\vec{b} \times \vec{a})$ is coplanar with

- (a) $\vec{a}$ only ☐
 (b) $\vec{b}$ only ☐
 (c) Both $\vec{a}$ and $\vec{b}$ ☐
 (d) Neither $\vec{a}$ nor $\vec{b}$ ☐

77. $\vec{a} \times (\vec{b} \times \vec{c}) = (\vec{a} \times \vec{b}) \times \vec{c}$ is true

- (a) Always ☐
 (b) Only if $\vec{b} \perp \vec{a}$ and $\vec{b} \perp \vec{c}$ ☐

(c) It either $\vec{a}$ and $\vec{c}$ are collinear or $\vec{b} \perp \vec{a}$ and $\vec{c}$ both ☐
 (d) Never ☐

78. If $\vec{a} = a_1 \vec{i} + a_2 \vec{j} + a_3 \vec{k}$
 $\vec{b} = b_1 \vec{i} + b_2 \vec{j} + b_3 \vec{k}$
 $\vec{c} = c_1 \vec{i} + c_2 \vec{j} + c_3 \vec{k}$

$$\text{and } \Delta = \begin{vmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{vmatrix}$$

then $\vec{a} \cdot \vec{b} \times \vec{c}$ is equal to

- (a) 2Δ ☐
 (b) $\frac{1}{2} \Delta$ ☐
 (c) $-\Delta$ ☐
 (d) Δ ☐

79. $\vec{a} \cdot (\vec{b} \times \vec{c})$ is a

- (a) Vector $\perp$ to both $\vec{a}$ and $(\vec{b} \times \vec{c})$ ☐
 (b) Vector $\perp$ to both $\vec{b}$ and $\vec{c}$ but parallel to $\vec{a}$ ☐

- (c) Vector $\perp$ to $\vec{a}$ ☐
 (d) None of the above ☐

80. Let $\vec{a}, \vec{b}, \vec{c} = [\vec{a} \ \vec{b} \ \vec{c}]$
 Which of the following statements is correct?

- $[\vec{a} \ \vec{b} \ \vec{c}]$ is same as
 (a) $[\vec{a} \ \vec{c} \ \vec{b}]$ ☐
 (b) $[\vec{c} \ \vec{a} \ \vec{b}]$ ☐
 (c) $[\vec{b} \ \vec{a} \ \vec{c}]$ ☐
 (d) $[\vec{c} \ \vec{b} \ \vec{a}]$ ☐

81. Let $\vec{a}, \vec{b}, \vec{c}$ be any three non-coplanar vectors. Let

$$\vec{X} = x_1 \vec{a} + x_2 \vec{b} + x_3 \vec{c}$$

$$\vec{Y} = y_1 \vec{a} + y_2 \vec{b} + y_3 \vec{c}$$

$$\vec{Z} = z_1 \vec{a} + z_2 \vec{b} + z_3 \vec{c} \text{ and}$$

$$\Delta = \begin{vmatrix} x_1 & x_2 & x_3 \\ y_1 & y_2 & y_3 \\ z_1 & z_2 & z_3 \end{vmatrix}$$

Then

$$(a) [\vec{X} \ \vec{Y} \ \vec{Z}] [\vec{a} \ \vec{b} \ \vec{c}] = \Delta$$

$$(b) [\vec{X} \ \vec{Y} \ \vec{Z}] = \Delta [\vec{a} \ \vec{b} \ \vec{c}]$$

$$(c) [\vec{X} \ \vec{Y} \ \vec{Z}] = \Delta^2 [\vec{a} \ \vec{b} \ \vec{c}]$$

$$(d) [\vec{X} \ \vec{Y} \ \vec{Z}] = \frac{1}{\Delta} [\vec{a} \ \vec{b} \ \vec{c}]$$

82. For any vectors $\vec{a}, \vec{b}, \vec{c}$
 $[\vec{a} + \vec{b}, \vec{b} + \vec{c}, \vec{c} + \vec{a}]$

is equal to

$$(a) [\vec{a}, \vec{b}, \vec{c}]$$

$$(b) 2[\vec{a}, \vec{b}, \vec{c}]$$

$$(c) 3[\vec{a}, \vec{b}, \vec{c}]$$

$$(d) 4[\vec{a}, \vec{b}, \vec{c}]$$

83. If $\vec{a}, \vec{b}, \vec{c}$ are any three non-coplanar vectors, then $\vec{a} \times \vec{b}, \vec{b} \times \vec{c}$ and $\vec{c} \times \vec{a}$

$$(a) \text{ Are coplanar}$$

$$(b) \text{ Are non-coplanar}$$

$$(c) \text{ Are either coplanar or non-coplanar}$$

$$(d) \text{ Are coplanar only when } \vec{a}, \vec{b}, \vec{c} \text{ are mutually orthogonal}$$

84. $(\vec{a} \times \vec{b}) \times \vec{c}$ is equal to

$$(a) (\vec{a} \cdot \vec{c}) \vec{b} - (\vec{b} \cdot \vec{c}) \vec{a}$$

$$(b) (\vec{a} \cdot \vec{b}) \vec{a} - (\vec{a} \cdot \vec{c}) \vec{c}$$

$$(c) (\vec{b} \cdot \vec{c}) \vec{a} - (\vec{b} \cdot \vec{a}) \vec{c}$$

$$(d) \text{ None of the above}$$

85. $|\vec{a} \times \vec{b}| = |\vec{a} \cdot \vec{b}|$ only if

$$(a) \vec{a} \parallel \vec{b}$$

$$(b) \vec{a} \perp \vec{b}$$

(c) $\vec{a}$ and $\vec{b}$ are inclined at an angle of 135°

(d) $\vec{a}$ and $\vec{b}$ are inclined at an angle of 45°

86. Let $\vec{a}, \vec{b}, \vec{c}$ be the position vectors of three points A, B, C respectively. Then the volume of the tetrahedron $OABC$ is given by

$$(a) \frac{1}{6} [\vec{a} \ \vec{b} \ \vec{c}]$$

$$(b) \frac{1}{3} [\vec{a} \ \vec{b} \ \vec{c}]$$

$$(c) \frac{1}{4} [\vec{a} \ \vec{b} \ \vec{c}]$$

$$(d) \frac{1}{5} [\vec{a} \ \vec{b} \ \vec{c}]$$

87. If $\vec{a}$ and $\vec{b}$ are any two vectors. Then

solution of the equation $\vec{r} \times \vec{b} = \vec{a} \times \vec{b}$ is given by

$$(a) \vec{r} = \vec{a}$$

$$(b) \vec{r} = \vec{a} + \lambda \vec{b} \text{ where } \lambda \text{ is any scalar}$$

$$(c) \vec{r} = \lambda \vec{a}$$

$$(d) \text{ None of the above}$$

88. The vector $\frac{\vec{b} \times \vec{c}}{[\vec{a} \ \vec{b} \ \vec{c}]}$ is a vector reciprocal to

$$(a) \vec{a}$$

$$(b) [\vec{a} \ \vec{b} \ \vec{c}]$$

$$(c) [\vec{a} \ \vec{b} \ \vec{c}] / (\vec{b} \times \vec{c})$$

$$(d) \text{ Either } \vec{b} \text{ or } \vec{c}$$

89. If $\vec{a}'$ is a vector reciprocal to $\vec{a}$, then which one is correct?

$$(a) \vec{a} \cdot \vec{a}' = 0$$

$$(b) \vec{a} \cdot \vec{a}' = 1$$

$$(c) \vec{a} \cdot \vec{a}' = \vec{a} \cdot \vec{a}$$

$$(d) \text{ None of the above}$$

90. The vector equation of a line passing through the given point with position vector $\vec{a}$ and parallel to given vector $\vec{b}$ is given by

- (a) $\vec{r} = \vec{a} + t\vec{b}$ ☐
 (b) $\vec{r} = \vec{b} + t\vec{a}$ ☐
 (c) $\vec{r} = s\vec{a} + t\vec{b}$ ☐
 (d) $\vec{r} = \vec{a} - t\vec{b}$ ☐
 where t and s are scalars ☐

91. Let t be any scalar. Then the vector equation of a straight line passing through two points whose position vectors are given by $\vec{a}$ and $\vec{b}$ respectively, is given by $\vec{r} = \lambda\vec{a} + \mu\vec{b}$ where

- (a) λ, μ are any scalars ☐
 (b) λ, μ are scalars such that $\lambda + \mu = 1$ ☐
 (c) λ, μ are scalars such that $\lambda + \mu = 0$ ☐
 (d) λ, μ are scalars such that $\lambda = \mu$ ☐

92. Which one of the following statements is incorrect?

The equation of the plane passing through the point $\vec{a}$ and parallel to the non-null vectors $\vec{b}$ and $\vec{c}$ is

- (a) $[\vec{r} \ \vec{b} \ \vec{c}] = [\vec{a} \ \vec{b} \ \vec{c}]$ ☐
 (b) $\vec{r} = \vec{a} + \lambda\vec{b} + \mu\vec{c}$, where λ and μ are any scalars ☐
 (c) Same as equation of the plane containing the two lines $\vec{r} = \vec{a} + \lambda\vec{b}$ and $\vec{r} = \vec{a} + \mu\vec{c}$ ☐
 (d) At least one of the above statements is incorrect ☐

93. The equation of the plane passing through $\vec{a}$ and $\vec{b}$ and parallel to a non-null vector $\vec{c}$ is given by

- (a) $[\vec{r} \ \vec{b} - \vec{a} \ \vec{c}] = [\vec{a} \ \vec{b} \ \vec{c}]$ ☐

- (b) $[\vec{r} - \vec{a} \ \vec{b} \ \vec{c}] = 0$ ☐
 (c) Both of the above ☐
 (d) None of the above ☐

94. The equation of the plane passing through the point A , whose position vector is $\vec{i} + \vec{j} + \vec{k}$, and parallel to the vectors $\vec{i}$ and $\vec{i} + \vec{j}$ is

- (a) $\vec{r} \cdot \vec{i} = 1$ ☐
 (b) $\vec{r} \cdot \vec{k} = 1$ ☐
 (c) $\vec{r} \cdot (\vec{i} + \vec{j} + \vec{k}) = 1$ ☐
 (d) None of the above ☐

95. The equation of the plane passing through three points A, B, C with position vectors $\vec{i} + \vec{j}, \vec{j} + \vec{k}, \vec{k} + \vec{i}$ is

- (a) $\vec{r} \cdot (\vec{i} + \vec{j} + \vec{k}) = 0$ ☐
 (b) $\vec{r} \cdot (\vec{i} + \vec{j} + \vec{k}) = 1$ ☐
 (c) $\vec{r} \cdot (\vec{i} + \vec{j} + \vec{k}) = 2$ ☐
 (d) $\vec{r} \cdot (\vec{i} + \vec{j} + \vec{k}) = 3$ ☐

96. The plane $\vec{r} \cdot \vec{a} = k$, where $\vec{a}$ is any vector and k is any scalar, passes through the point whose position vector is

- (a) $\frac{k \cdot \vec{a}}{\vec{a} \cdot \vec{a}}$ ☐
 (b) $\frac{k \cdot \vec{a} \cdot \vec{a}}{\vec{a}}$ ☐
 (c) $\frac{k}{\vec{a} \cdot \vec{a}}$ ☐
 (d) $\frac{k}{\vec{a}}$ ☐

97. The general solution of the equation $\vec{r} \cdot \vec{a} = k$ is given by $\vec{r} =$

- (a) $\frac{k}{\vec{a}}$, where k is any scalar ☐

$$(b) \frac{\vec{k} \cdot \vec{a}}{\vec{a} \cdot \vec{a}} + t \cdot \vec{a} \times \vec{b} + p \cdot \vec{a} \times \vec{c}$$

where k, t, p are any scalars

$$(c) \frac{\vec{k} \cdot \vec{a}}{a^2}$$

(d) None of the above

98. If $\vec{r} \times \vec{b} = \vec{a} \times \vec{b}$ where $\vec{a}$ and $\vec{b}$ are

any vectors, then $\vec{r} =$

$$(a) \vec{a}$$

$$(b) \frac{\vec{a} \times \vec{b}}{\vec{b}}$$

(c) $\vec{a} + t \vec{b}$ where t is any scalar

(d) None of the above

99. If $\vec{r} \times \vec{b} = \vec{a}$ where $\vec{a}$ and $\vec{b}$ are any vectors such that $\vec{a}$ and $\vec{b}$ are perpendicular, then $\vec{r} =$

$$(a) \frac{\vec{a}}{\vec{b}}$$

$$(b) -\frac{\vec{a} \times \vec{b}}{\vec{b} \cdot \vec{b}} + y \vec{b} \text{ where } y \text{ is any scalar}$$

$$(c) \vec{O}$$

(d) None of the above

ANSWERS

- | | | | | | |
|-------|-------|-------|-------|-------|-------|
| 1. d | 2. b | 3. b | 52. c | 53. a | 54. a |
| 4. c | 5. a | 6. a | 55. b | 56. a | 57. c |
| 7. d | 8. c | 9. b | 58. a | 59. c | 60. d |
| 10. b | 11. c | 12. c | 61. b | 62. c | 63. d |
| 13. b | 14. a | 15. b | 64. a | 65. c | 66. d |
| 16. c | 17. c | 18. d | 67. b | 68. b | 69. a |
| 19. c | 20. b | 21. b | 70. b | 71. d | 72. b |
| 22. d | 23. c | 24. d | 73. d | 74. b | 75. a |
| 25. a | 26. d | 27. a | 76. c | 77. c | 78. d |
| 28. b | 29. a | 30. a | 79. d | 80. b | 81. b |
| 31. b | 32. c | 33. b | 82. b | 83. b | 84. a |
| 34. a | 35. c | 36. c | 85. d | 86. d | 87. b |
| 37. b | 38. a | 39. b | 88. a | 89. b | 90. a |
| 40. b | 41. d | 42. d | 91. b | 92. d | 93. a |
| 43. c | 44. a | 45. a | 94. b | 95. c | 96. a |
| 46. d | 47. b | 48. c | 97. b | 98. c | 99. b |
| 49. d | 50. b | 51. c | | | |

Mechanics

1. Laws of motion were first discovered in 1600 by
 - (a) Newton ☐
 - (b) Galileo ☐
 - (c) Archemides ☐
 - (d) None of the above ☐
2. Which one of the following is not a force ?
 - (a) Weight ☐
 - (b) Attraction ☐
 - (c) Acceleration ☐
 - (d) Tension ☐
3. Force has
 - (a) Magnitude only ☐
 - (b) Direction only ☐
 - (c) Magnitude and direction both ☐
 - (d) Direction but may or may not have magnitude ☐
4. If a body of certain mass is taken from the earth to the moon, then
 - (a) Its mass will remain the same on earth as well as on the moon ☐
 - (b) Its mass on the moon will be one-sixth of that on the earth ☐
 - (c) Its mass on the moon will be one-third of that on the earth ☐
 - (d) None of the above statements is correct ☐
5. Force is defined as
 - (a) The rate of change of momentum of the body ☐
 - (b) The product of mass and acceleration of a body ☐
 - (c) An entity proportional to the acceleration of a body ☐
 - (d) An entity which either changes or tends to change the state of the body ☐
- from rest or from uniform motion in a straight line in the direction in which it is acting ☐
6. The resultant velocity obtained by adding two velocities 30 km/hour towards north and 50 km/hour towards south-east is equal to
 - (a) 80 km/hour ☐
 - (b) 20 km/hour ☐
 - (c) 36 km/hour ☐
 - (d) None of the above ☐
7. The resultant of two forces
 - (a) Always exists ☐
 - (b) Exists only when they are parallel ☐
 - (c) Exists only when they are perpendicular ☐
 - (d) Exists only when they are concurrent ☐
8. If two forces acting at a point are in equilibrium, then the condition that they are equal and opposite is
 - (a) Necessary and sufficient both ☐
 - (b) Necessary but not sufficient ☐
 - (c) Sufficient but not necessary ☐
 - (d) Neither necessary nor sufficient ☐
9. Let R be the resultant of two forces F_1 and F_2 acting at a point. If the force F_1 is reversed, the resultant is turned through a right angle. Which one of the following statements is correct ?
 - (a) Forces must be equal in magnitude but opposite in direction ☐
 - (b) Forces must be different in magnitude ☐
 - (c) Forces must be equal in magnitude ☐
 - (d) The angle between the forces must be greater than 90° and less than 180° ☐
10. Which one of the following statements is correct ?

- (a) Two collinear forces acting on a rigid body are never in equilibrium ☐
- (b) Two non-collinear forces acting on a rigid body can never be in equilibrium ☐
- (c) Two non-collinear forces acting on a rigid body are in equilibrium if they are of same magnitude ☐
- (d) Two non-collinear forces acting on a rigid body are not necessarily in equilibrium ☐

11. Two forces $mF_1 + nF_2$ and $nF_1 - mF_2$ are acting at a point inclined at an angle α to each other and their resultant is

$$\sqrt{(m^2 + n^2)(F_1^2 + F_2^2)}$$

Then α is equal to

- (a) $\pi/2$ ☐
- (b) 0 ☐
- (c) π ☐
- (d) None of the above ☐

12. Two forces F_1 and F_2 are acting at a point and are inclined to each other at an angle of 120° . If their resultant makes an angle 90° with the direction of F_1 , then

- (a) $F_1 = \sqrt{3} F_2$ ☐
- (b) $F_1 = F_2$ ☐
- (c) $2F_1 = F_2$ ☐
- (d) $2F_2 = F_1$ ☐

13. The resultant of two forces F_1 and F_2 is R_1 . If the direction of F_1 is reversed, the resultant becomes R_2 . Then

- (a) $F_1^2 + F_2^2 = 2(R_1^2 + R_2^2)$ ☐
- (b) $R_1 = R_2$ ☐
- (c) $R_1 = 2R_2$ ☐
- (d) $2(F_1^2 + F_2^2) = R_1^2 + R_2^2$ ☐

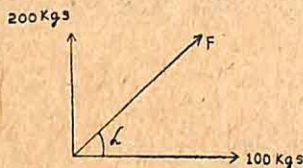
14. If three forces acting on a rigid body are in equilibrium, then they must be

- (a) Concurrent ☐
- (b) Parallel ☐
- (c) Coplanar or concurrent ☐
- (d) Coplanar and concurrent (or parallel) ☐

15. Who among the following mathematicians proved that "Three forces acting at a point are in equilibrium iff each of them is proportional to the sine of the angle between the other two"?

- (a) Lagrange ☐
- (b) Lami ☐
- (c) Newton ☐
- (d) Hooke ☐

16. If the three forces acting at a point (as shown in the figure) are in equilibrium, then



- (a) $\alpha = \pi + \tan^{-1} 2$ and $F = 100\sqrt{5}$ kgs ☐
- (b) $\alpha = \tan^{-1} 2$ and $F = 100\sqrt{3}$ kgs ☐
- (c) $\alpha = \tan^{-1} \frac{1}{2}$ and $F = 100$ kgs ☐
- (d) $\alpha = \tan^{-1} \frac{1}{2}$ and $F = 300$ kgs ☐

17. For the equilibrium of a number of forces the condition, that the forces are represented both in magnitude and direction by the sides of a polygon taken in order, is

- (a) Only necessary ☐
- (b) Only sufficient ☐
- (c) Both necessary and sufficient ☐
- (d) Neither necessary nor sufficient ☐

18. Let X, Y, Z be the sum of the components of n forces $F_1, F_2, \dots, F_n$ acting at a point, in three mutually perpendicular directions. Then the forces are in equilibrium if

- (a) $X = Y = Z = 0$ ☐
- (b) $X + Y + Z = 0$ ☐
- (c) $X = Y = Z$ ☐
- (d) $X + Y = 0, Y + Z = 0$ and $Z + X = 0$ ☐

19. Let X, Y, Z be the sum of the components of n forces $F_1, F_2, \dots, F_n$ acting at a point in three mutually perpendicular directions. Let R be the magnitude of their resultant. Then $R =$

- (a) $\sqrt{X^2 + Y^2 + Z^2}$ ☐
- (b) $X^2 + Y^2 + Z^2$ ☐
- (c) $\frac{X + Y + Z}{3}$ ☐
- (d) None of the above ☐

20. For the system of n coplanar forces acting at a point, to be in equilibrium, the condition that the resultant of any $(n-1)$ of them is equal to the remaining force in magnitude as well as direction, is

- (a) Both necessary and sufficient ☐
 (b) Neither necessary nor sufficient ☐
 (c) Necessary but not sufficient ☐
 (d) Sufficient but not necessary ☐

21. For the system of n coplanar and parallel forces to be in equilibrium, the condition that the algebraic sum of their magnitudes is zero, is

- (a) Necessary but not sufficient ☐
 (b) Neither necessary nor sufficient ☐
 (c) Both necessary and sufficient ☐
 (d) Sufficient but not necessary ☐

22. Let $F_1, F_2, \dots, F_n$ be the n coplanar forces acting at a point and let R be the resultant of $F_2, F_3, \dots, F_n$. If the forces $F_1, F_2, \dots, F_n$ are in equilibrium, then F_1 and R are

- (a) Same in magnitude and direction both ☐
 (b) Same in magnitude but opposite in direction ☐
 (c) Perpendicular to each other ☐
 (d) Different in magnitude and direction ☐

23. If a force F is resolved into two components P and Q making angles α and β respectively with it, then

- (a) $P = \sin(\alpha + \beta) \cdot F \cos \alpha$
 $Q = \sin(\alpha + \beta) \cdot F \cos \beta$ ☐
 (b) $P = \frac{F \sin \alpha}{\sin(\alpha + \beta)}, Q = \frac{F \sin \beta}{\sin(\alpha + \beta)}$ ☐
 (c) $P = \frac{F \sin \beta}{\sin(\alpha + \beta)}, Q = \frac{F \sin \alpha}{\sin(\alpha + \beta)}$ ☐
 (d) $P = F \cos \alpha, Q = F \cos \beta$ ☐

24. Suppose three forces F_1, F_2 , and F_3 are acting along the sides BC, AC and BA of an equilateral triangle ABC . The resultant of these forces is parallel to F_1 and passes through the centroid. Then

- (a) $F_1 = F_2 = F_3$ ☐
 (b) $F_2 = F_3 = 2F_1$ ☐
 (c) $F_2 + F_3 = 2F_1$ ☐
 (d) $F_2 = F_3 = \frac{1}{2}F_1$ ☐

25. Moment of a force F about a point is a

- (a) Signed number ☐
 (b) Positive number ☐
 (c) Negative number ☐
 (d) Vector quantity ☐

26. Suppose three forces F_1, F_2 and F_3 act along the sides BC, CA and AB of a triangle ABC respectively. If their resultant passes through the incentre of the triangle, then

- (a) $F_1 = F_2 = F_3$ ☐
 (b) $F_1 \cos A + F_2 \cos B + F_3 \cos C = 0$ ☐
 (c) $F_1 + F_2 + F_3 \neq 0$ ☐
 (d) $F_1 + F_2 + F_3 = 0$ ☐

27. Suppose three forces F_1, F_2, F_3 act along the sides BC, CA and AB of a triangle ABC respectively. If their resultant passes through the orthocentre of the triangle, then

- (a) $F_1 \sin A + F_2 \sin B + F_3 \sin C = 0$ ☐
 (b) $F_1 \cos A + F_2 \cos B + F_3 \cos C = 0$ ☐
 (c) $F_1 + F_2 + F_3 = 0$ ☐
 (d) $F_1 \sec A + F_2 \sec B + F_3 \sec C = 0$ ☐

28. If the three forces F_1, F_2 and F_3 act along the sides BC, CA and AB respectively of a triangle ABC and if their resultant passes through the circumcentre of the triangle, then

- (a) $F_1 + F_2 + F_3 = 0$ ☐
 (b) $F_1 + 2F_2 + 3F_3 = 0$ ☐
 (c) $F_1 \cos A + F_2 \cos B + F_3 \cos C = 0$ ☐
 (d) $F_1 \sec A + F_2 \sec B + F_3 \sec C = 0$ ☐

29. If the three forces F_1, F_2 and F_3 act along the bisectors of the angles A, B, C of a triangle ABC and if they are in equilibrium, then they are in the ratio of

- (a) $\cos A : \cos B : \cos C$ ☐
 (b) $\sin A : \sin B : \sin C$ ☐
 (c) $\sin A/2 : \sin B/2 : \sin C/2$ ☐
 (d) $\cos A/2 : \cos B/2 : \cos C/2$ ☐

30. If the resultant of two forces represented by the sides AB, AC of a triangle ABC pass through the circumcentre of the triangle, then

- (a) Either $AB = AC$ or $\angle A = 90^\circ$ ☐
 (b) $AB = AC$ ☐

- (c) $\angle A = 90^\circ$ ☐
 (d) $AB = AC$ and $\angle A = 90^\circ$ ☐

31. Newton's first law states "Every body continues in its state of——except in so far as it is compelled by impressed forces to change that state"

- (a) Rest ☐
 (b) Uniform motion in a straight line ☐
 (c) Motion in a straight line ☐
 (d) Rest or uniform motion in a straight line ☐

32. If P , v , m and f denote the impressed force, velocity, mass and acceleration respectively, then according to Newton's second law of motion

- (a) $P = mf$ ☐
 (b) $P = k \frac{dv}{dt}$, k being constant ☐
 (c) $P = kmf$ ☐
 (d) $f = kmp$ ☐

33. Let P be a particle of mass m and let F denote the resultant force on P and f be the acceleration, then according to Newton's second law of motion

- (a) $F = mf$ ☐
 (b) $f = mF$ ☐
 (c) $F = -mf$ ☐
 (d) $F = mgf$ ☐

34. Let two particles of masses m_1 and m_2 be at a distance r from each other. If the mutual force of attraction is F , then by law of gravitation

- (a) $F = \frac{m_1 m_2}{r}$ ☐
 (b) $F \propto \frac{m_1 m_2}{r}$ ☐
 (c) $F = \frac{m_1 m_2}{r^2}$ ☐
 (d) $F \propto \frac{m_1 m_2}{r^2}$ ☐

35. A particle P is moving in a line with a velocity varying as the n th power ($n > 1$) of its distance from a fixed point O to which it is approaching. If T is the time taken by the particle to reach the point O , then

- (a) $T = \infty$ ☐
 (b) $T < \infty$ ☐
 (c) T increases as n increases ☐
 (d) T increases as n decreases ☐

36. Let the displacement of a particle moving in a straight line be given by $\frac{1}{2}tv$. Then the acceleration is

- (a) Zero ☐
 (b) Constant ☐
 (c) Inversely proportional to t ☐
 (d) Inversely proportional to t^2 ☐

37. If a body is falling freely under gravity, then the acceleration

- (a) Is zero ☐
 (b) Is uniform ☐
 (c) Varies as the square of the distance travelled ☐
 (d) Varies as the inverse of the distance travelled ☐

38. Let a particle be moving in a line with a constant acceleration f . If x_1 and x_2 are the distances travelled in times t_1 and t_2 respectively, then

- (a) $f = \frac{2(t_1 x_1 + t_2 x_2)}{t_1 t_2 (t_1 + t_2)}$ ☐
 (b) $f = \frac{2(t_2 x_1 - t_1 x_2)}{t_1 t_2 (t_1 - t_2)}$ ☐
 (c) f cannot be determined ☐
 (d) $f = \frac{2(x_1 + x_2)}{t_1 + t_2}$ ☐

39. A rocket is fired vertically upwards with a velocity u and if there is a target at height h , then

- (a) The rocket reaches the target only if $u > \sqrt{2gh}$ ☐
 (b) The rocket reaches the target only if $u \geq \sqrt{2gh}$ ☐
 (c) The rocket reaches the target only if $u \geq 2\sqrt{gh}$ ☐
 (d) The rocket will never reach the target ☐

40. A rocket is fired vertically upwards with a velocity which exceeds $\sqrt{2gh}$, where h is the height of a target. If t_1 and t_2 are the instants at which the rocket reaches the target, then

(a) $t_1 + t_2 = \frac{2u}{g}$ ☐

(b) $t_1 - t_2 = \frac{2u}{g}$ ☐

(c) $t_1 + t_2 < \frac{2u}{g}$ ☐

(d) $t_1 + t_2 = \frac{u}{g}$ ☐

41. A particle moving along a parabola $y = ax^2$ in such a way that its x -component of velocity is constant. If $\ddot{y}$ is the acceleration in y -direction, then

(a) $\ddot{y} \propto x^2$ ☐

(b) $\ddot{y} = 0$ ☐

(c) $\ddot{y} \propto x$ ☐

(d) $\ddot{y}$ is constant ☐

42. A particle is moving in a straight line with uniform acceleration f and initial velocity u . Let x_n be the distance travelled in the n th second. Then

(a) $x_n = u + \frac{1}{2} f.n$ ☐

(b) $x_n = u + \frac{1}{2} f(2n-1)$ ☐

(c) $x_n = u.n + f$ ☐

(d) x_n cannot be determined ☐

43. The simple harmonic motion of the particle is governed by the equation

$$\frac{d^2x}{dt^2} = -\mu x,$$

where x is the distance of the particle from some fixed point. Then

(a) μ is always positive ☐

(b) μ is always negative ☐

(c) μ may be positive or negative ☐

(d) None of the above ☐

44. A particle executes S.H.M. between the points A and B . Let O be the fixed point. Then the period of oscillation is defined as

(a) Time taken by the particle from A to B ☐

(b) Time taken by the particle from A to B and back ☐

(c) Square of the time taken by the particle from A to B ☐

(d) $\sqrt{2\pi\mu}$ ☐

45. The frequency n of a simple harmonic motion is defined as

(a) Half the number of complete oscillations in one second ☐

(b) The number of complete oscillations in one second ☐

(c) $\frac{2\pi}{T}$ where T is a period of oscillation ☐

(d) $\sqrt{\frac{2\pi}{T}}$ ☐

46. A particle of mass m executes S.H.M. between A and B . Let O be the middle point of AB and $AB = 2d$. Then amplitude is

(a) $\sqrt{2}d$ ☐

(b) $\sqrt{d}$ ☐

(c) d ☐

(d) A vector quantity ☐

47. Let a particle be in S.H.M. between A and B and O be the fixed middle point. Then as the particle moves beyond O ,

(a) Velocity and acceleration both increase ☐

(b) Velocity and acceleration both decrease ☐

(c) Velocity increases but acceleration decreases ☐

(d) Velocity decreases but acceleration increases ☐

48. The S.H.M. of a particle is governed by the equation

$$\frac{d^2x}{dt^2} = -\mu x,$$

the solution of which is given by

$$x = A \cos(\sqrt{\mu} t + \alpha).$$

Then the argument is the angle

(a) $\sqrt{\mu} t$ ☐

(b) α ☐

(c) $\sqrt{\mu} t + \alpha$ ☐

(d) None of the above ☐

49. In Q. 48, Epoch is the quantity

(a) A ☐

(b) $\sqrt{\mu} t$ ☐

- (c) t ☐
 (d) α ☐

50. Which of the following displacements x of a particle moving in a straight line always describes a S.H.M. at any time t ?

- (a) $x = A \cot \alpha t + B \sin \beta t$; where A, B, α, β are any real numbers ☐
 (b) $x = A \cos \alpha t + B \sin \alpha t$ ☐
 (c) $x = A \cosh \alpha t + B \sinh \alpha t$ ☐
 (d) None of the above ☐

51. S.H.M. is

- (a) Always periodic ☐
 (b) Never periodic ☐
 (c) Periodic only when its centre of oscillation is at the origin ☐
 (d) Periodic only when its amplitude is less than one ☐

52. A particle is moving in such a way that its radial and transverse velocities are always proportional to each other. Then the path of the particle is given by $a/\alpha n$

- (a) Parabola ☐
 (b) Ellipse ☐
 (c) Circle ☐
 (d) Equiangular spiral ☐

53. Let P be a given particle whose radial and transversal velocities as well as accelerations are both proportional. If r is the radial distance, then velocity

- (a) $\propto r^2$ ☐
 (b) $\propto \log r$ ☐
 (c) $\propto$ some power of radius vector ☐
 (d) None of the above ☐

54. A particle moves along the path of the curve $r = ae^{\theta}$. Then the angular velocity is constant if

- (a) Radial component of acceleration is zero ☐
 (b) Transversal component of acceleration is zero ☐
 (c) Transversal component of acceleration is proportional to r ☐
 (d) Any one of the above holds ☐

55. The path of a projectile in vacuum is $a/\alpha n$

- (a) Parabola ☐
 (b) Semi-circle ☐
 (c) Arc of the ellipse with semi-major axis vertical ☐
 (d) None of the above ☐

56. A particle of mass m is thrown in the vacuum with velocity u and angle of projection α . Then the position of the particle at any point t is given by

- (a) $x = u \cos \alpha \cdot t, y = u \sin \alpha \cdot t$ ☐
 (b) $x = u \cos \alpha - gt, y = u \sin \alpha - gt$ ☐
 (c) $x = u \cos \alpha \cdot t, y = u \sin \alpha \cdot t - \frac{1}{2}gt^2$ ☐
 (d) None of the above ☐

57. The maximum height to which a projectile goes when thrown with initial velocity u at an angle α , is given by

- (a) $\frac{u^2 \sin^2 \alpha}{2g}$ ☐
 (b) $\frac{2u^2 \sin^2 \alpha}{g}$ ☐
 (c) $\frac{u^2 \sin^2 \alpha}{g}$ ☐
 (d) $\frac{u^2 \sin 2\alpha}{2g}$ ☐

58. Let T_H and T be the time taken by a projectile upto the highest point and the time of flight respectively. Then

- (a) $T_H = 2T/3$ ☐
 (b) $T_H = \frac{1}{2}T$ ☐
 (c) $T = u \sin \alpha \cdot T_H$ ☐
 (d) $T_H = 2T$ ☐

59. If a particle is projected with a velocity u at an angle α , then which of the following statements is incorrect?

- (a) If $\alpha = 45^\circ$, range is maximum ☐
 (b) If $\alpha = 45^\circ$, range is minimum ☐
 (c) If $\alpha = 45^\circ$, the time to the highest point is $\frac{u}{g\sqrt{2}}$ ☐
 (d) If $\alpha = 45^\circ$, the range is maximum and is given by $\frac{u^2}{2g}$ ☐

60. Let two particles A and B be projected from a point in the same plane at the same time. Then the curve described by B relative to A is

- (a) Always a parabola ☐
 (c) Always a circle ☐
 (c) Always a straight line ☐
 (d) None of the above ☐

61. A number of particles are projected from the same point O with the same velocity u in different directions in the same vertical plane. At any time t , the particles lie on a

- (a) Circle with centre at O ☐
 (b) Parabola ☐
 (c) Straight line ☐
 (d) Circle with centre ut ☐

In Q. 62—69, let $r(r, \theta)$ be the position vector of a particle at time t .

62. The velocity of a particle is given by

- (a) r ☐
 (b) $\dot{r}$ ☐
 (c) $|\dot{r}|$ ☐
 $\rightarrow$
 (d) $\frac{r}{r}$ ☐

63. If $r=1$, then velocity of the particle

- (a) Is zero ☐
 $\rightarrow$
 (b) Is parallel to r ☐
 $\rightarrow$
 (c) Is perpendicular to r ☐
 (d) Is of magnitude one ☐

64. The magnitude of the angular velocity of the line joining the origin to the particle is given by

- (a) $r\dot{\theta}$ ☐
 (b) $\dot{\theta}$ ☐
 (c) $\frac{\dot{\theta}}{r}$ ☐
 (d) $r^2\dot{\theta}$ ☐

65. Let v be the velocity of a particle at time t , then the angular velocity of the line joining the origin to the particle is given by

- $\rightarrow$
 (a) $\frac{v}{r}$ ☐
 $\rightarrow \rightarrow$
 (b) $\frac{v \cdot r}{r}$ ☐

$$\rightarrow \rightarrow$$

$$(c) \frac{r \times v}{r^2}$$

$$\rightarrow \rightarrow$$

$$(d) \frac{v \times r}{r^2}$$

66. The radial acceleration of the particle is given by

- (a) $\ddot{r}$ ☐
 (b) $r\ddot{\theta}$ ☐
 (c) $\ddot{r} + r\dot{\theta}^2$ ☐
 (d) $\ddot{r} - r\dot{\theta}^2$ ☐

67. The transverse acceleration of the particle is given by

- (a) $r\ddot{\theta} + 2\dot{r}\dot{\theta}$ ☐
 (b) $r\ddot{\theta} + \dot{r}\dot{\theta}$ ☐
 (c) $2r\dot{\theta} - r\ddot{\theta}$ ☐
 (d) None of the above ☐

68. The magnitude of the angular acceleration of the line joining the origin to the particle is given by

- (a) $\ddot{\theta}$ ☐
 (b) $r\ddot{\theta}$ ☐
 (c) $\dot{r}\dot{\theta}$ ☐
 (d) $\dot{r}\ddot{\theta}$ ☐

69. The magnitude of the velocity of the particle is given by

- (a) $|\dot{r} + r\dot{\theta}|$ ☐
 (b) $|\dot{r}| + |r\dot{\theta}|$ ☐
 (c) $\sqrt{\dot{r}^2 + \dot{\theta}^2}$ ☐
 (d) $\sqrt{\dot{r}^2 + (r\dot{\theta})^2}$ ☐

70. If a particle moves along a circle $r=2a \cos \theta$ such that its acceleration towards the origin is always zero, then the transverse acceleration of the particle varies as

- (a) $\operatorname{cosec} \theta$ ☐
 (b) $\sin \theta$ ☐
 (c) $\cos \theta$ ☐
 (d) $\operatorname{cosec}^2 \theta$ ☐

71. If a particle moves along a spiral with a constant speed, then

- (a) The transverse velocity of the particle varies as the radial distance ☐
 (b) Only the transverse velocity of the particle is constant ☐
 (c) Both the radial and the transverse velocities of the particle are constant ☐
 (d) Only the radial velocity of the particle is constant ☐

72. If a particle is moving along the curve $r = ae^{\theta}$ such that the angular velocity of the line joining the origin to the particle is constant, then the radial acceleration of the particle

- (a) Is zero ☐
 (b) Is non-zero ☐
 (c) Varies as r ☐
 (d) Varies as r^2 ☐

73. The radial and transverse velocities of a particle are non-zero constants, then the path of the particle is a/an

- (a) Spiral ☐
 (b) Circle ☐
 (c) Cardioid ☐
 (d) Ellipse ☐

74. A particle is moving along a cycloid $s = 4a \sin \psi$ in such a way that the rate of change of its direction is constant, then the acceleration of the particle is

- (a) Of constant magnitude ☐
 (b) In a fixed direction ☐
 (c) Constant both in magnitude and direction ☐
 (d) Neither constant in magnitude nor in direction ☐

75. If the radial and transverse velocities of a particle at the point (r, θ) be respectively λr and $\mu \theta$ where λ, μ are constants, then the radial and transverse accelerations are

- (a) λ and μ respectively ☐
 (b) $\lambda^2 r - \mu^2 \frac{\theta^2}{r}$ and $\mu \theta \left(\lambda + \frac{\mu}{r} \right)$ respectively ☐
 (c) $\lambda^2 r + \mu^2 \frac{\theta^2}{r}$ and $\mu \theta \left(\frac{\mu}{r} - \lambda \right)$ respectively ☐
 (d) None of the above ☐

ANSWERS

1. b	2. c	3. c	40. a	41. d	42. b
4. a	5. d	6. c	43. a	44. b	45. b
7. d	8. a	9. c	46. c	47. d	48. c
10. b	11. a	12. c	49. d	50. b	51. a
13. d	14. d	15. b	52. d	53. c	54. a
16. a	17. b	18. a	55. a	56. c	57. a
19. a	20. b	21. a	58. b	59. d	60. c
22. b	23. c	24. d	61. d	62. b	63. c
25. a	26. d	27. d	64. b	65. c	66. d
28. c	29. d	30. a	67. a	68. a	69. d
31. d	32. c	33. a	70. d	71. c	72. a
34. d	35. a	36. d	73. a	74. a	75. b
37. b	38. b	39. b			

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